

**HYPERION FULL SECONDARY
MASTER SCHEDULING SPECIFICATION**

SCHEDULE

The Hyperion Full Secondary Schedule Specification is almost the same as the Wastewater Program Contractors Construction Schedule and Reports (Long Form), except that it is formatted to the HFS General Requirements format, and is intended for use on all Hyperion Full Secondary Projects greater than \$10 million or on moderately sized projects with a high degree of interface with other projects.

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SEPTEMBER 9, 1992**

9. SCHEDULE

9.1 Progress of the Work

It is expressly understood and agreed that the time of beginning, the rate of progress, and the time of completion of the work are of the essence to this Contract. The work shall be executed with such progress as required to prevent any delay to other contractors working on other contracts at the Hyperion site, the Contract milestones, and the general completion of the Contract.

9.2 Contractor's Construction Scheduler

- (a) The Contractor is required to employ or retain the services of a Construction Scheduler. The Construction Scheduler shall have at least five (5) years of verifiable experience as the person primarily responsible for preparing and maintaining detailed project schedules on projects of the same or similar size and nature as this project. The Construction Scheduler is required to attend all meetings pertaining to scheduling and progress of the work. If the Construction Scheduler leaves the employ of the Contractor, the Contractor will be required to fulfill the requirements of Section 9.2(b) within thirty (30) days. (As used in this Section, "days" mean consecutive calendar days unless otherwise noted.)
- (b) Within five (5) days after the Notice of Award the Contractor shall provide a statement to the Engineer with the following:
 - (1) Identification, qualifications, and experience of the Contractor's Construction Scheduler and all other members of the Contractor's scheduling staff.
 - (2) References of not less than two (2) previous projects on which the Contractor's Construction Scheduler has utilized CPM scheduling.
 - (3) A description of the Scheduling System to be utilized.

- (c) The Engineer and the Inspector reserve the right to disapprove any candidate or Scheduling System proposed for the project. The Engineer and the Inspector reserve the right to remove, without rights to work on the project, any member of the Contractor's scheduling staff that is, in the Engineer's or Inspector's opinion, incompetent in scheduling.

9.3 General

(a) Schedule Methodology

The scheduling method to be used shall be a Critical Path Method schedule in the form of an activity on arrow (I-J format) oriented network diagram or activity on node Precedence Diagram Network (PDN) with capabilities of identifying the critical path. The principles and definitions of the terms used herein shall be as set forth in the Associated General Contractor's publication "CPM in Construction", latest edition. To the extent there are any conflicts between the Associated General Contractor's publication and the Specifications, the Specifications shall govern.

(b) Work Breakdown Structure

- (1) The Contractor shall submit to the Engineer for approval, at the Preconstruction Scheduling Conference, the following:
 - (i) A work breakdown structure;
 - (ii) The associated alpha-numeric coding structure to implement the work breakdown structure;
 - (iii) The activity identification system for labelling all work activities;
- (2) The first code field shall designate the bid item. The second code field shall identify the type of activity. (Types of activities shall be defined as "submittal", "review/approval", "procurement/fabrication", "delivery", "construction/installation" or "change order".) The third code field shall identify which Specification section the activity shall be paid under. The fourth code field shall identify who is responsible to perform the activity (i.e., Contractor,

Subcontractor(s) by trade, Supplier, etc.). The fifth code field shall identify the area being worked in or the facility, if appropriate. The sixth code field shall identify the construction phase or project element (if phasing of work or project elements are identified in the Contract.) All Change Orders and Notices of Non-Compliance shall be included as separate code fields.

(c) Scheduling System

The Contractor shall use Primavera Project Planner, Version 5.0 or a later version, and a hardware system commensurate with the size of the project. This shall be referred to as the Scheduling System. The system shall be capable of handling, processing, printing, and plotting data to satisfy all requirements of Section 9. The Contractor shall maintain the Scheduling System, the schedule, and the scheduling staff on site or at a location approved by the Engineer.

9.4 Preconstruction Scheduling Conference

The Engineer will schedule and conduct a Preconstruction Scheduling Conference with the Contractor's Project Manager, General Superintendent, and Construction Scheduler within seven (7) days after Notice of Award, to commence development of the required project schedule. At this meeting, the requirements of this Section, as they apply to the Contract, will be reviewed with the Contractor. The Contractor shall be prepared to review and discuss methodology for the schedule and sequence of operations plus cost, manpower, and equipment loading methodology.

9.5 Contractor's Preliminary Project Schedule

- (a) Within fifteen (15) days after the Preconstruction Scheduling Conference, the Contractor shall submit to the Engineer the Preliminary Project Schedule, which shall be a detailed plan of operations for the first ninety (90) days of work after Notice to Proceed, as well as a general approach for the remainder of the work.
- (b) The Engineer, the Inspector, and the Contractor shall meet within seven (7) days after submittal of the Preliminary Project Schedule to review and make any necessary adjustments or revisions. The Preliminary Project Schedule, when revised, will

represent the Contractor's planned means, methods, and sequences for performance of the work during the first ninety (90) days after Notice to Proceed and is to be incorporated as the first ninety (90) days of the Contractor's Detailed Project Schedule.

- (c) The Contractor shall submit the revised Preliminary Project Schedule within five (5) days after the meeting, for approval by the Engineer and the Inspector within five (5) days after the submittal.
- (d) At the same time, and as part of the submittal of the Preliminary Project Schedule, the Contractor shall submit to the Engineer and the Inspector, for approval, a schedule of manpower and costs assigned to each activity on the Preliminary Project Schedule. Costs assigned will generally conform to the Contractor's bid item unit prices and such lump sum bid item breakdowns as the Inspector shall approve. The schedule of manpower and costs shall be realistic and level so as to not have any unusual manpower requirements.
- (e) The resultant Preliminary Project Schedule, when approved by the Engineer and the Inspector, shall be the sole basis of partial or progress payments made for work performed during the first ninety (90) calendar days after Notice to Proceed.
- (f) Submittal and approval of the Preliminary Project Schedule is a condition precedent to the issuance and payment of progress payments. Therefore, no construction work will be permitted and no progress payments will be made until the Preliminary Project Schedule has been approved by the Engineer and the Inspector.
- (g) The Preliminary Project Schedule shall be updated monthly during the first ninety (90) days after Notice to Proceed, as a part of the payment application process. All appropriate reports and network diagrams required by Subsection 9.8 shall be submitted, as agreed upon between the Engineer, the Inspector, and the Contractor.

9.6 Contractor's Detailed Project Schedule

- (a) Fifteen (15) days after approval of the Preliminary Project Schedule, the Engineer shall meet with the Contractor to receive an update on the progress in the development of the Detailed Project Schedule. The Contractor shall prepare and submit to the

Engineer the Detailed Project Schedule within forty five (45) days after approval of the Preliminary Project Schedule.

- (b) The Detailed Project Schedule shall show the sequence and interdependence of activities required for complete performance of the work, beginning with the date of the Notice to Proceed, and concluding with the date of Final Completion of the Contract.
- (c) Pursuant to the float sharing requirements of the Contract, use of float suppression techniques such as preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates shall be cause for rejection of the Detailed Project Schedule and any revisions or updates. The use of float time disclosed or implied by the use of alternative float suppression techniques shall be shared as directed by the Engineer.
- (d) If the Contractor submits a Detailed Project Schedule showing completion of the work more than thirty (30) work days in advance of the Contract completion date, the Contractor agrees that the Engineer may, at no cost to the City, decrease the Contract duration by issuance of a change order which will change the appropriate Milestone Date(s) and the Contract completion date to the completion date reflected on the Detailed Project Schedule. Any approved schedule, revision, or update having an early completion date shall show the time between the early completion date and the current Contract completion date as "project float".
- (e) The Engineer will review and make comments on the Detailed Project Schedule. Meetings will be held between the Engineer, the Contractor, and all major Subcontractors and Suppliers to resolve any conflicts between the Detailed Project Schedule and the intent of the Contract. (The term "major Subcontractors and Suppliers" as used in this Section, shall include any Subcontractor or Supplier with five (5) percent or more of the value of the Contract.) Other Subcontractors or Supplier representatives whom the Contractor may desire to invite or whom the Engineer may request, shall attend.
- (f) Comments made by the Engineer on the Detailed Project Schedule, during review, will not relieve the Contractor from compliance with requirements of

the Contract Documents. To the extent that there are any conflicts between the approved schedule and the requirements of the Contract Documents, the Contract Documents shall govern.

- (g) If requested by the Engineer, the Contractor shall provide highly detailed, short-term schedules for specific crucial items (work-arounds, start-up, etc.). The Contractor will be compensated for the cost of including change orders on the Detailed Project Schedule, if such changes are required or requested by the Engineer. All such inclusions shall be incorporated into the schedule at a fixed fee of \$200 per change order.

9.7 Network Details

- (a) The Detailed Project Schedule for the Contract shall include time-scaled network diagrams, based on working days, as well as computer tabulations. It shall be constructed to show the order in which the Contractor proposes to carry out the work, to indicate restrictions of access and to show availability of work areas, and availability and use of manpower, materials and equipment. The Contractor shall utilize the Detailed Project Schedule in planning, scheduling, coordinating, and performing the work under the Contract (including all activities of Subcontractors, equipment vendors, and Suppliers). The Contractor will provide the Engineer with written confirmation of the concurrence of the major trade Subcontractors and Suppliers with the Detailed Project Schedule and all revisions and updates.
- (b) The following criteria shall form the basis for assembly of the schedule logic:
 - (1) Which activity must be completed before a subsequent activity can be started?
 - (2) Which activities can be done concurrently?
 - (3) Which activity must be started immediately following a completed activity?
 - (4) What major economic facility or manpower restrictions are required for sequencing these activities?
- (c) The Detailed Project Schedule shall provide the Engineer with a tool to monitor and follow the

progress of all phases of the work. The Detailed Project Schedule submitted to the Engineer shall comply with all limits imposed by the scope of work, with all contractually specified intermediate milestone and completion dates, and with all constraints, restraints or sequences included in the Contract. The degree of detail shall include factors to the satisfaction of the Engineer, including, but not limited to:

- (1) Physical and structural breakdown of the project;
- (2) Contract milestones and completion dates, substantial completion dates, constraints, restraints, sequences of work shown in the Contract, the planned substantial completion date, and the final completion date;
- (3) Type of work to be performed, the sequences, and the labor trades involved.
- (4) All purchase, submittals, submittal reviews, manufacture, tests, delivery, and installation activities for all major materials and equipment, and a separate list of all major material items or items of equipment for which the Contractor intends to seek payment prior to installation;
- (5) Deliveries of City furnished equipment and/or materials in accordance with the dates or schedule windows of such items set forth in the Contract or furnished by the Engineer;
- (6) Preparation, submittal and approval of shop and/or working drawings and material samples showing a thirty (30) day minimum time specified for the Engineer's review of normal or routine submittals and a forty five (45) day review time for all major submittals, so identified in the Specifications, and the same timeframe shall be allowed for at least one (1) resubmittal on all major submittals so identified in the Contract Documents;
- (7) Approvals required by regulatory agencies or other third parties;
- (8) Plans for all subcontract work;
- (9) Assignment of responsibility for performing

specific activities;

- (10) Access and availability to work areas;
 - (11) Identification of interfaces and dependencies with preceding, concurrent and follow-on Contractors and utilities;
 - (12) Resource loading for cost, manpower, material, and equipment;
 - (13) Actual tests, submission of test reports, and approval of test results;
 - (14) All start up, testing, training, and assistance required under the Contract;
 - (15) Planning for phased or total takeover by the City;
 - (16) Punchlist and final cleanup; and
 - (17) Identification of any manpower, material, or equipment restrictions, as well as any activity requiring unusual shift work, such as two shifts, six (6) day weeks, specified overtime, or work at times other than regular days or hours, shall be clearly identified in the Detailed Project Schedule.
- (d) The activities included in the Detailed Project Schedule shall be analyzed in detail to determine activity time durations in units of project working days. Durations shall be based on the labor (crafts), equipment, and materials required to perform each activity on a normal work day basis. No on-site activity shall have a duration over fifteen (15) working days except non-construction activities such as submittals, submittal reviews, procurement and delivery of materials or equipment, and concrete curing. Only on-site construction activities will be shown in their resource loaded state to reflect cost, manpower, materials and equipment except for those activities specifically identified under Subsection 9.7(c)(4). All durations shall be the result of definitive manpower and resource planning by the Contractor to perform the work in consideration of contractually defined on-site work conditions. The manpower to be assigned, by craft definition, and equipment, by item designation, shall be shown for each construction activity for the network on a tabular

listing, and included in information furnished in accordance with Subsections 9.16 and 9.17. All crafts necessary to execute an activity must be shown. No more than five (5) crafts may be assigned to a specific activity. If more crafts are required, then the activity in question must be broken down into additional activities.

- (e) The Contractor is required to use manpower or equipment restraints, separately noted, to optimize and level manpower and equipment requirements. Such resource leveling shall reflect a reasonable plan for accomplishing the work. The individual activities involved may be sequenced within the limits of the available total float. However, when this leveling technique is used in establishing the initial schedule, it shall be reflected in the logic with restraints identified as "restraint for manpower or equipment leveling purposes only." Critical or near critical paths resulting from the use of manpower restraints shall be kept to a minimum. Near critical paths shall be defined as those paths having fifteen (15) working days or less of total float at the time of initial submission.
- (f) The estimated cost to perform each work activity shall be noted for each activity in the network on a tabular listing. The sum of the costs assigned to all activities shall equal the Contract value. No activity costs shall be assigned to submittals or submittal reviews. The accepted cost loaded Detailed Project Schedule shall constitute the Schedule of Values from which monthly progress payments will be made in accordance with the requirements of General Condition Section, PAYMENTS.
- (g) The network diagram shall be prepared on (E) size sheets (28 inches by 40 inches), shall have a title block in the lower right-hand corner, and a timeline on each page. Exceptions to the size of the network sheets and the use of computer graphics to generate the networks shall be subject to the approval of the Engineer.
- (h) All networks shall be drafted time scaled to show a continuous flow of information from left to right. The primary path(s) of criticality shall be clearly and graphically identified on the network(s).
- (i) As part of each update submission, the status of

work in progress shall also be similarly identified and the reported percent complete graphically indicated for each activity remaining in progress as of the last report period.

9.8 Detailed Project Schedule Reports

- (a) The Detailed Project Schedule submitted to the Engineer shall include the time scaled network diagram (for the full network of activities as well as the Master Summary Schedule described below). Network diagrams shall be based on early start and early finish dates of activities shown. The network diagrams submitted to the Engineer shall also be accompanied by a computer-generated mathematical analysis for each activity included in the Detailed Project Schedule. Such mathematical analysis shall be submitted to the Engineer and shall include as a minimum, the following:
- (1) Predecessor and successor activity numbers and descriptions;
 - (2) Activity number and description;
 - (3) Activity code(s);
 - (4) Schedule and actual/remaining duration for each activity;
 - (5) Earliest start date (by calendar date);
 - (6) Earliest finish date (by calendar date);
 - (7) Actual start date (by calendar date);
 - (8) Actual finish date (by calendar date);
 - (9) Latest start date (by calendar date);
 - (10) Latest finish date (by calendar date);
 - (11) Float in work days;
 - (12) Monetary value of each activity;
 - (13) Percentage of activity completed and remaining duration for incomplete activities;
 - (14) Cumulative value of work completed, based on the Contractor's reported portion of activities completed and accepted.

The computer program(s) used in making the mathematical computation shall be capable of compiling the total dollar value of complete and partially complete activities. The program shall also be capable of accepting revised completion dates, as modified by approved time extensions, and re-computing all activity dates and float accordingly.

- (b) The following computer outputs shall be required as part of the Detailed Project Schedule Submittal and each revision or update thereafter as a condition precedent to receipt of progress payments:
- (1) Activity sort by preceding event (I-J) or activity number (PDN) from lowest to highest;
 - (2) Activity sort by the amount of total float, then in order of preceding event or activity number;
 - (3) Activity sort by early start, for the next ninety (90) days, then in order of preceding event or activity number;
 - (4) Activity sort(s) by organizational responsibility including submittals to the Engineer for all major items of material and equipment, the number of shifts, crew sizes of each craft; and construction equipment to accomplish the activity. Outputs (1) and (2) above shall show all activities including restraints for the duration of the project.
 - (5) A sublisting of materials and equipment sorted by specification section number. The sublisting of materials and equipment shall include the following activities: preparation of shop drawings, submittal to the Engineer, review by the Engineer, and fabrication, testing, and/or delivery of material and equipment which shall be interfaced with the earliest start date that the material or equipment is to be installed on the project.
- (c) Outputs (a) and (b) above shall show all activities, including restraints for the duration of the project.
- (d) The Contractor shall also prepare and submit a time-scaled Master Bar Chart Summary Schedule on a single sheet that shows the total project in

approximately 25-100 activities, as agreed to by the Contractor and the Engineer. This schedule will accurately summarize the current Detailed Project Schedule and shall have common events for correlating the two levels of schedule indenture. All Contract milestones shall be shown. The Master Summary Schedule shall be updated monthly.

- (e) The Contractor shall submit to the Engineer, a printed copy of the Predecessor/Successor Report. The data to provide all other schedule reports called for in this Subsection may be submitted on computer diskette(s). If such data is provided on diskette(s), all reporting requirements of the Engineer and the Inspector will be fulfilled by the Engineer.

9.9 Approval of Baseline Detailed Project Schedule

- (a) The Detailed Project Schedule network diagram and computer tabulations, the Master Summary Schedule, the Cash Flow Projection, and the Manpower Requirements Forecast shall be submitted to the Engineer for approval within forty five (45) calendar days after approval of the Preliminary Project Schedule in the following quantities:
 - (1) Detailed Network Diagram and Summary Schedules (an original and three (3) sets of prints);
 - (2) Computer tabulations (three (3) copies 8 1/2" x 11" in size);
 - (3) Manpower Requirements Forecast (three (3) copies 8 1/2" x 11" in size);
 - (4) Cash Flow Projection (three (3) copies 8 1/2" x 11" in size).
 - (5) All required reports specified in Subsection 9.7 and 9.8 (three (3) copies).
 - (6) Written confirmation of concurrence of all major trade Subcontractors and Suppliers.
- (b) The Contractor shall provide to the Engineer printed copies of the Detailed Network Diagram and Summary Schedules. The data required to provide all schedule reports called for in this Subsection may be provided on diskette(s). If such data is provided on diskette(s), all reporting requirements of the Engineer and the Inspector will be fulfilled

by the Engineer. If additional submittals are necessary, diskette(s) for each submittal shall be provided by the Contractor.

(c) Approval Process:

- (1) The Engineer shall approve or disapprove, in writing, the Contractor's submission within twenty one (21) days after receipt of all required information. The Detailed Project Schedule, once approved, becomes the Baseline Record Schedule which shall be used for monitoring and evaluating all facets of Contract performance, including, but not limited to: progress, changes, and delays; and shall be referred to as the Record Schedule.
- (2) The Contractor, the Contractor's Construction Scheduler, and all major trade Subcontractors shall be required to participate in all meetings necessary to reach mutual agreement and approval of the initial Detailed Project Schedule, the Master Summary Schedule, the Manpower Requirements Forecast, and the Cash Flow Projection.
- (3) The Contractor shall revise the schedule, as required by the Engineer, to reflect project construction. If any of the required submissions are returned to the Contractor for corrections or revisions, they shall be resubmitted along with a new computer diskette(s) and a hard copy listing of each change for approval within seven (7) days after receipt. Resubmittals shall be as required in Subsection 9.9(a) and (b). Review and response by the Engineer shall be given within seven (7) days after receipt of each new submission.
- (4) Should the Baseline Detailed Project Schedule, submitted for approval, show variances from the requirements of the Contract, the Contractor shall make specific mention of such variations in the letter of transmittal, in order that, if accepted, proper adjustments to the Detailed Project Schedule can be made. Otherwise, the Contractor will not be relieved of the responsibility for executing the work in strict accordance with the requirements of the Contract Documents.

- (5) Failure of the Contractor to submit the initial Detailed Project Schedule, the Master Summary Schedule, the Manpower Requirements Forecast, the Cash Flow Projection, major trade Subcontractor and Supplier confirmation in writing, or the computer diskette(s), within the time prescribed, or revisions thereof within the required time, it is within the Engineer's discretion to stop the Contractor's work at no additional cost to the City. Further, no Mobilization Progress payments shall be made until such time as the Contractor submits the required information and obtains approval of the Baseline Detailed Project Schedule. Approval of the Baseline Project Schedule is a condition precedent to payment of any portion of the Mobilization Payment.
- (6) Failure of the Contractor to submit the Baseline Detailed Project Schedule or any required resubmittals, in a timely, accurate manner and in accordance with the requirements of this Section will result in costs to the City which are difficult if not impossible to determine; therefore, the Contractor shall pay the City liquidated damages in the amount of \$3,000 per work day, for every work day the schedule submittal, revision, or resubmittal is late. This amount shall be subtracted from any monies due and shall be forfeited by the Contractor.

9.10 Revisions to Approved Baseline Detailed Project Schedule

- (a) The Contractor shall prosecute the work in accordance with the approved Baseline Detailed Project Schedule. Out of sequence construction, defined as a change in the Detailed Project Schedule, requires prior approval of the Engineer as defined below.
- (b) Upon approval of a Change Order, or issuance of an Emergency Change Authorization (ECA), a Time and Material (T&M) Change Order or a unilateral Change Order, the change shall be reflected in the next schedule submittal by the Contractor.
- (c) No change to the approved Baseline Detailed Project Schedule or the Record Schedule shall be made without the prior written approval of the Engineer. If the Contractor desires to make a change to the

approved Baseline Detailed Project Schedule, the Contractor shall request permission from the Engineer in writing, stating the reasons for the change as well as the specifics, such as revisions to activities, logic, durations, etc. The Engineer will provide a response within five (5) days.

- (d) If the Engineer considers a schedule change to be of a major nature, the Engineer may require the Contractor to revise and submit for acceptance all of the affected portion(s) of the Detailed Project Schedule and an analysis to show the effect on the entire project. The proposed revision and analysis shall be submitted to the Engineer within fifteen (15) days after the Engineer notifies the Contractor the revision is of a major nature. A change will be considered to be of a major nature if the time estimated for an activity or sequence of activities is varied from the original plan to the degree that there is reasonable doubt that the Contract completion date will be met, or if the change impacts the work of other Contractors at the jobsite. Changes to activities having adequate float shall be considered as minor changes, except that an accumulation of minor changes may be considered a major change when such changes affect the Contract completion date. (Activities having adequate float are activities which are not critical after the change is made.)
- (e) Only upon approval of a change by the Engineer shall it be reflected in the next schedule update submitted by the Contractor.

9.11 Updates to Approved Baseline Detailed Project Schedule and Progress Payments

- (a) Monthly Update Meetings:
 - (1) All updated or revised schedules shall be submitted in the same detail as the original submittal, unless modified in writing by the Engineer, and shall include written confirmation of the major trade Subcontractors and Suppliers.
 - (2) The initial updating shall be submitted within the first week after approval of the Baseline Detailed Project Schedule. The updating shall be cost and resource loaded. Subsequent updates shall be submitted at the beginning of each month thereafter for the duration of the

Contract. The Detailed Project Schedule and computer tabulations shall be reviewed jointly by the Contractor's Project Manager and Construction Scheduler and representatives of all major Subcontractors and Suppliers at a joint update meeting with the Engineer and the Inspector for the purpose of verifying:

- (i) Actual start dates;
- (ii) Actual completion dates (when an activity is deemed substantially complete by the Engineer and the Inspector, then such activity will no longer be treated as an activity affecting the critical path or successor activities on the project);
- (iii) Cost value of accepted work reported in place;
- (iv) Activity percent completion;
- (v) Incorporation of approved changes and approved time extensions;
- (vi) Status of outstanding Notices of Non-Compliance.

(b) Monthly Updated Schedules:

- (1) The Contractor shall submit the Monthly Update Schedule to the Engineer each month, on a date assigned by the Engineer. The proposed update schedule prepared by the Contractor shall include all information available as of the cutoff date established by the Engineer. A detailed list of all proposed schedule changes (logic, duration, status, additions, and deletions) and revised histograms and tabular reports for manpower and construction equipment as required by Subsections 9.16 and 9.17 shall be submitted with the update. Prior to the monthly update review meeting, the Contractor shall obtain from his Subcontractors, Suppliers, and staff the necessary information as required to reflect progress to date. A proposed Monthly Update Schedule containing the information set forth below shall be available for review at the meeting.

- (i) For activities started and/or completed

during the previous period: Actual start and actual completion dates, number of work days, number of shifts, crew sizes by craft, and construction equipment used to accomplish the activity.

- (ii) For activities begun but not yet complete to date, number of shifts, crew sizes by craft, construction equipment required, remaining duration of the work, and estimated completion date.
- (iii) For activities not yet started: Estimated start dates, number of shifts, crew sizes by craft, construction equipment required, revised durations, and estimated completion dates, as necessary.
- (iv) For authorized Change Orders, including Emergency Change Authorizations, T&M changes and Unilateral Change Orders: Revised activities, number of shifts, crew sizes by craft, construction equipment required, and durations, where required.
- (v) The monthly update of the Detailed Network Diagram shall be for the month preceding the meeting and for the remainder of the project. The previous month's activities shall be reported as they actually took place and designated as actually complete, if actually completed, on the network diagram update.
- (vi) Portions of the Detailed Network Diagram on which all activities are complete need not be reprinted and submitted in subsequent updates. However, the electronic disk file of the submitted Detailed Network Diagrams and the related reports shall constitute a clear record of progress of the work from Notice to Proceed to final completion.
- (vii) The monthly submittal to the Engineer shall be accompanied by a bound Schedule Narrative Report. The Schedule Narrative Report shall describe the physical progress during the report period, plans for continuing the work during the forthcoming report period, actions

planned to correct any negative float predictions, and an explanation of potential delays and/or problems and their estimated impact on performance and the overall project completion date. In addition, alternatives for possible schedule recovery to mitigate any potential delay and/or cost increases shall be included for consideration by the Engineer. The bound report shall follow the outline set forth below:

Contractor's Schedule Narrative Report Outline:

- * Contractor's Transmittal Letter
- * Description of problem areas
- * Current and anticipated delays
 - Cause of the delay
 - Corrective action and schedule adjustments to correct the delay
 - Impact of the delay on other activities, milestones, and completion dates
- * Changes in construction sequences
- * Pending items and status thereof
 - Permits
 - Change Orders
 - Time extensions
 - Non-Compliance Notices
- * Contract completion date(s) status
 - Ahead of schedule and number of working days
 - Behind schedule and number of working days
- * Other project or scheduling concerns
- * Include reviewed and updated Detail Network Diagram and Reports
- * Include revised Cost Loading and Cash Flow Information (Subsection 9.13)
- * Include revised manpower information (Subsection 9.16)
- * Include revised construction equipment information (Subsection 9.17)

(viii) The Contractor shall provide to the Engineer, printed copies of the Predecessor/Successor Report, a printed list of all changes made to the

previously approved Record Schedule, and the Schedule Narrative Report. The data required to provide all other scheduling reports called for in this Subsection may be provided on computer diskette(s). If such data is provided on diskette(s), all reporting requirements of the Engineer and the Inspector will be fulfilled by the Engineer.

- (c) The Contractor, the Contractor's Construction Scheduler, and representatives of all major trade Subcontractors and Suppliers shall attend the monthly update meetings with the above data prepared in advance for each meeting to provide, as of the end of the updating period, a complete and accurate report of the current procurement schedule (in accordance with the requirements of General Condition Section, QUALITY CONTROL: MONTHLY PROCUREMENT AND DELIVERY STATUS REPORT), construction progress, and a depiction of how the Contractor plans to continue the work of the project to meet all Contract completion dates. All network changes and status dates agreed to during each update meeting shall be considered as acceptable by all parties unless written notice of exception is given by an objecting party within five (5) days after the update meeting. For major network changes that cannot be agreed to during an update meeting, the Contractor shall submit, in writing, such revisions for the Engineer's approval prior to inserting such changes into the network. Submissions may be in the form of marked-up networks, fragnets, or schedule abstracts provided they are submitted with a letter of transmittal. The submission and approval procedures for this information shall follow the same timetable described in Subsection 9.15.
- (d) Predicated on the results of the Engineer's review of monthly submissions of the updated Detailed Project Schedule or Record Schedule and accompanying reports, the Contractor may be required to revise the Detailed Project Schedule. Conditions under which a revision will be made are as follows:
- (1) When a delay in the completion of any work item or sequence of work items results in an indicated extension of the project completion or interim milestone dates detailed herein by ten (10) working days.

- (2) When delays in submittals or deliveries or work stoppages are encountered which make replanning, rescheduling, or resequencing of the work necessary.
 - (3) When the schedule does not represent the actual prosecution and progress of the project.
- (e) Required revisions of the Monthly Update Schedules are due within five (5) days of notice by the Engineer that a revision is required. All revisions and additions to the Detailed Project Schedule are subject to the review of the Engineer. No changes are to be implemented in the schedule by the Contractor without the prior approval of the Engineer. When the Monthly Schedule Update or its required revision is approved by the Engineer, it then becomes the Current Record Schedule. The Current Record Schedule will be used for the period from which it is approved until its successor is submitted and approved.
- (f) Three (3) copies each of the Schedule Narrative Report, the updated Detailed Project Schedule (networks, and computer computations), the Summary Master Schedule, the Cash Flow Projection, the updated network diagram, updated computer disk reflecting the status of the project agreed to at the updating meeting, and the Manpower Requirements Forecast shall be submitted to the Engineer within five (5) days after each updating meeting in accordance with Subsection 9.11(b)(1)(viii).
- (g) The update report shall show the activities or portions of activities completed during the reporting period and their total value as the basis for the Contractor's periodic request for payment. Payments made pursuant to General Condition Section, PAYMENTS, will be based on the total value of such activities completed or partially completed after verification by the Inspector. The report shall state the percentage of the work actually completed and scheduled as of the report date and the progress along the critical path in terms of days ahead or behind the allowable dates. If the project is behind schedule, progress along other paths with negative float shall also be reported.
- (h) Failure of the Contractor to submit schedule updates in a timely, accurate manner and in accordance with the requirements of this section

will result in costs to the City which are difficult, if not impossible to determine; therefore, the Contractor shall pay the City liquidated damages in the amount of \$3,000 per work day for every work day the submittal is late or not in full compliance with the requirements of this section. This amount shall be deducted from any monies due, and forfeited by the Contractor. In addition to the liquidated damages, if the Contractor continues to fail to submit any of the update deliverables, or to meet any of the other updating requirements, for a period of thirty (30) days or more beyond the required submittal date, progress payments will be withheld until such time as the Contractor submits the required update requirements.

9.12 Weekly Progress Reports

(a) Once each week, on a date established by the Engineer, the Contractor shall submit two progress schedules:

- (1) The first shall be a progress schedule listing the activities completed and in progress for the previous week and the activities scheduled for the succeeding two (2) weeks. The activity designations shall be consistent with the activity designations in the current Record Schedule. A bar chart shall be used to display the information in pictorial form.
- (2) The second shall be a utility work/access alteration report and a schedule listing the activities completed by activity designation from the current Record Schedule and in progress for the previous week and the activities scheduled for the succeeding four (4) weeks. This report and schedule shall include any and all work on the plant's operational utilities, equipment, process piping, sewers, and like detail as well as access alterations.

9.13 Cost Loading and Cash Flow

(a) With the initial Detailed Project Schedule submittal, each monthly update, and each revision, the Contractor shall also submit a schedule of cost loading and cash flow to the Engineer. There shall be a strict correlation between the sum of individual activity costs and the total values

indicated for bid items. That is, each individual activity within the Detailed Project Schedule shall employ a code which, in summary, attaches its cost, if any, to the appropriate bid items. The sum of activity costs within a specific code, then, shall equal the cost of its corresponding bid items and approved Change Orders.

- (b) Expected payment requests for each month shall be included with proposed updates, as well as the cumulative payment requests to date for each month of the project. The net payment requests for each month and the cumulative payment requests to date shall also be shown after deducting retainage and any other monies withheld. The cash flow shall be shown in tabular format and in graphic format.
- (c) The Contractor, at the Preconstruction Scheduling Conference, shall explain in detail the procedure to be used to develop the schedule activity cost loading and cash flow. This procedure is subject to the review and approval of the Engineer and the Inspector. Receipt and approval of the Schedule Cost Loading and Cash Flow Summary is a condition precedent to the making of any payments under the Contract. Therefore, failure to submit an acceptable schedule cost loading and cash flow summary shall be cause for withholding any progress payments due or that may become due under this Contract, until such time as an acceptable cost loading and cash flow summary is received.
- (d) In accordance with the updating procedures, when an activity is deemed substantially complete by the Engineer, then such activity will no longer be treated as an activity affecting the critical path or successor activities on the project. The cost of correction of any punchlist items associated with substantially completed activities will be covered by withheld retention or other amounts deemed by the Engineer to be adequate to cover such costs.

9.14 Responsibility for Completion

- (a) Whenever it becomes apparent from the current monthly update progress review meeting or the monthly updated Detailed Project Schedule that phasing, milestone, constraint, restraint, or Contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:

- (1) Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 - (2) Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 - (3) Reschedule the work in conformance with the Specification requirements.
- (b) Prior to implementing any of the above actions, the Contractor shall notify and obtain approval from the Engineer. If such actions are approved, the Detailed Project Schedule revisions shall be incorporated by the Contractor into the Network Diagram before the next update.
- (c) Under no circumstances will the addition of equipment or construction forces, increasing the working hours or any other method, manner, or procedure to return to the contractually required completion date be considered justification for a Change Order or be treated as acceleration where the need for a recovery schedule has been caused by the Contractor and/or its Subcontractors or Suppliers, at any tier.
- (d) The Engineer may elect to withhold progress payments until the Contractor's progress indicates that the milestone date(s) and/or the Contract completion date will be met.

9.15 Schedule Time Extensions

- (a) When Change Orders or delays are experienced by the Contractor and a time extension is requested, the Contractor shall submit to the Engineer, a written Time Impact Analysis illustrating the influence of each change or delay on the current Contract schedule completion date utilizing the current approved Record Schedule. Each Time Impact Analysis shall include a fragnet demonstrating how the Contractor proposes to incorporate the Change Order or delay into the Record Schedule. A fragnet is defined as a sequence of new and/or activity revisions that are proposed to be added to the approved Baseline Detailed Project Schedule or Record Schedule in effect at the time the change or delay is encountered to demonstrate the influence

of the delay and the method for incorporating the delay and its impact into the schedule as they are encountered.

- (b) Each Time Impact Analysis shall demonstrate the estimated time impact based on the events of delay, the date the Preliminary Change Order, Emergency Change Authorization, the T&M change, or the unilateral Change Order was given to the Contractor, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the Record Schedule, in effect at the time the change or delay was encountered.
- (c) Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining float along the critical path of activities at the time of actual delay, or at the time the Preliminary Change Order, the Emergency Change Authorization, the T&M Change Order, or the unilateral Change Order was issued. Float or slack time is not for the exclusive use or benefit of the Engineer or the Contractor but is an expiring resource available to all parties as needed to meet Contract milestones and the Contract completion date. Time extensions shall not be granted nor delay damages paid until
 - (i) A delay occurs which is beyond the control and without the fault or negligence of the Contractor and its Subcontractors or Suppliers, at any tier; and
 - (ii) Which extends actual performance of the work beyond the applicable current Contract completion date and the most recent date predicted for completion of the project on the approved schedule update current as of the time of the delay or as of the time of issuance of the Preliminary Change Order, the Emergency Change Authorization, the T&M change, or the unilateral Change Order.
- (d) Each Time Impact Analysis shall be submitted in triplicate, within fifteen (15) days after a delay occurs, or issuance of the Preliminary Change Order, Emergency Change Authorization, T&M Change Order, or unilateral Change Order. If the

Contractor does not submit a Time Impact Analysis for a specific Change Order or delay within the specified period of time, the contractor shall be deemed to have irrevocably waived any rights to additional time and cost.

- (e) Since float time within the Detailed Project Schedule and the Record Schedule is jointly owned, it is acknowledged and agreed by the Contractor that City caused delays on the project may be offset by City caused time savings (including, but not limited to: critical path submittals returned in less time than allowed for in the Contract, approval of substitution requests which result in a savings of time along the critical path for the Contractor, etc.). In such an event, the Contractor shall not be entitled to receive an extension of time or delay damages until all City caused time savings are exceeded and the Contract completion date also exceeded.
- (f) Approval or rejection of each Time Impact Analysis by the Engineer shall be made within fifteen (15) days after receipt of each Time Impact Analysis, unless subsequent meetings and negotiations are necessary. Upon approval, a copy of a Time Impact Analysis signed by the Engineer shall be returned to the Contractor for incorporation into the schedule.
- (g) Upon mutual agreement by both parties, fragnets illustrating the influence of Change Orders and delays shall be incorporated into the Detailed Project Schedule or Record Schedule during the first update after agreement is reached.
- (h) In the event the Contractor does not agree with the decision of the Engineer regarding the impact of a change or delay, it shall be resolved in accordance with General Condition Section, DISPUTES.

9.16 Manpower

The Contractor shall submit with the initial Detailed Project Schedule a histogram depicting total project craft manpower and craft manpower for its own forces and for each of its Subcontractors for each month. The histogram shall be based upon and shall be in substantive agreement with the number of shifts and crew sizes by craft in the Detailed Project Schedule and shall be updated monthly and submitted with the monthly progress report. The update shall show actual manpower for each

month during the construction period to date and required manpower for both base scope and Change Order work each month necessary to complete all remaining activities, including Change Order work, to insure timely project completion.

9.17 Construction Equipment

The Contractor shall submit with the initial Detailed Project Schedule a tabular report listing each major piece of construction equipment and each major piece of construction equipment for each of its Subcontractors for each month. Each major piece of the Contractor's and the Subcontractor's equipment shall be separately described, identified, and numbered in the report. The tabular report shall be based upon and in substantive agreement with the number of shifts and crew sizes by craft in the Detailed Project Schedule and shall be updated monthly and submitted with the monthly progress report. The update shall show actual construction equipment for each month during the construction period to date and required construction equipment for each month necessary to complete all remaining activities, including Change Order work, on the early finish date.

9.18 Submittal of As Built Schedule

As a condition precedent to the release of retention, the last update to the Record Schedule submitted shall be identified by the Contractor as the "As Built Schedule". The "As Built Schedule" shall reflect the exact manner in which the project was actually constructed (including start and completion dates, activities, sequences, and logic) and shall be certified by the Contractor's Project Manager and Construction Scheduler as being a true reflection of the way the project was actually constructed.

9.19 Recorder of the Schedule

- (a) Following the Engineer's approval of the Baseline Detailed Project Schedule, the Engineer will input the schedule into the Engineer's computer. The Engineer will then reproduce the Baseline Detailed Project Schedule and transmit it to the Contractor for verification. The Contractor shall, within fifteen (15) days of the transmittal, authenticate the schedule, acknowledging that the schedule is, in fact, the Contractor's schedule, or advise the Engineer in writing of the reason(s) for not

authenticating it. Once the schedule has been authenticated, it will be known as the Baseline Record Schedule, and all performance will be measured against it. The Engineer will be the Recorder of the Baseline Record Schedule.

- (b) The Engineer shall also be the Recorder of the monthly updates of the Record Schedule. Revisions and updates to the Record Schedule shall be as described in Subsections 9.10 and 9.11, and shall be input by the Engineer following acceptance of the proposed revision or update. Statusing of the Record Schedule shall be performed by the Engineer utilizing the information provided by the Contractor in the Weekly Progress Reports required by Subsection 9.12, after the information has been verified by the Engineer and the Inspector. Once a month, on a date selected by the Engineer, a copy of the monthly update of the Record Schedule shall be transmitted to the Contractor for verification. The Contractor shall, within ten (10) days of transmittal, either authenticate the schedule, acknowledging that the schedule is, in fact, the Contractor's schedule, or advise the Engineer in writing of the reason(s) for not authenticating it. Once the monthly update is authenticated, it will be known as the Monthly Update of the Record Schedule for the specified month.
- (c) Once the Contractor has authenticated the Baseline Record Schedule and the Monthly Update of the Record Schedule these documents will be the only official construction schedules. It shall be further understood that any scheduling effects of delays or Change Orders or any scheduling basis of claims shall be based upon the Record Schedules.
- (d) The provisions of Subsection 9.19 do not relieve the Contractor of any other requirement of Section 9, SCHEDULE.

WASTEWATER PROGRAM
MASTER SCHEDULING SPECIFICATIONS

CONTRACTORS CONSTRUCTION SCHEDULE AND REPORTS

(LONG FORM)

For use on projects greater than \$10 million or on moderately sized projects with a high degree of complexity or multiple interfaces with other projects.