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Tracking Project Commodities for Progress Control

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Abstract

Traditional VDOT construction project tracking focuses on the overall project progress. If overall project progress begins to fall behind the intended plan, the plan must be deciphered as to what aspects of the project are behind schedule. Tracking project commodities for project control focuses on selecting significant commodity outputs associated with the project. By tracking the selected commodities, the focus for determining progress of the overall project is enhanced by including commodities. By tracking commodities in conjunction with the overall project progress, the progress of the overall project, as well as the progress of selected commodity outputs, can be assessed.

Introduction

Parties within the construction industry must be able to deliver a quality product under schedule constraints in order to keep pace with their competitors. These parties include contractors, owners, and suppliers. The common goal of these parties is to deliver construction projects in timely manner. Companies and managers that want to optimize the construction process by keeping delays to a minimum know that they must utilize a means of tracking to ensure that appropriate progress is made at any given point in the schedule. For any construction company to survive, the company must keep their projects on schedule by selecting which commodities they should track throughout the construction of a project, and make the appropriate changes to maintain healthy progress (Kerzner 2004).

One problem that many construction participants experience is project failure usually due to delays during the construction phase. Some contractors do not make use of a Critical Path Method (CPM) schedule during their construction projects. Many do not create a practical CPM schedule, failing to produce a schedule with a reasonable level of detail that would make the schedule an effective tool for managing the project. Some contractors do not even have the resources or skilled personnel to generate such schedules. The higher level of detail that is defined within that schedule, the greater control project teams will have on the project as it progress (de la Garza 2006, Westney 1985).

A typical construction project focuses on several aspects of schedule control to ensure effective implementation of the construction schedule. The proper level of planning is of great importance before a construction project begins, in that schedule and commodity baselines are established to measure progress. Proper vision for the project must be established before construction is executed. Once the construction begins, progress must be monitored in the field to ensure that the project is progressing as planned. Data from the monitored commodities must then be compared to track, report, and analyze the progress of construction throughout the project. By tracking and reporting on the project progress, the probability that the project will have the desired outcome is much higher.

This project & report focuses on the first three steps of Figure 1, and applying it the project commodities. It will focus on taking a project schedule and using it to establish baselines for commodity progress throughout the project. Commodities can then be monitored as construction takes place. The reports of actual commodity progress can then be compared against the planned commodities to determine the progression of the project at various intervals throughout the project.

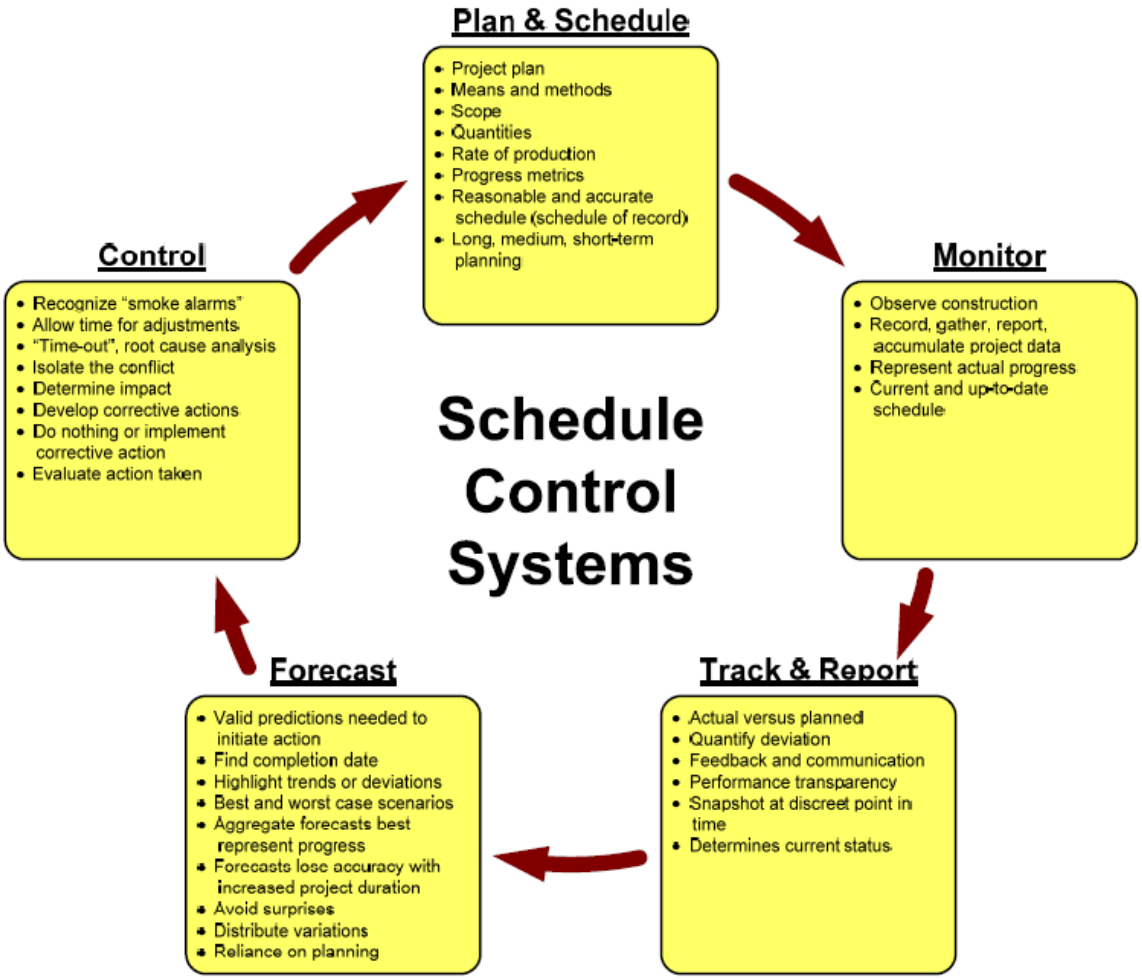


Figure 1: Framework for Schedule Control (Arcuri 2007)

In the construction industry, there is sometimes confusion between the definition of commodities and resources. The difference between a resource and a commodity is that resources are the inputs required to complete construction activities, whereas commodities are the outputs resulting from the construction activities. A resource is any form of labor or equipment necessary to complete an activity. Examples of resource inputs include (but are not limited to):

- Individual laborers
- Crews (groups organized by their trade)
- Machinery
- Equipment
- Collections of equipment based on their use
- Groups of resources used in conjunction with each other (Harris 2004)

Resource inputs within a construction schedule can also be used to level a CPM schedule. Resource-loaded schedules are designed to optimize a construction CPM-developed schedule around the resources necessary for each activity. It takes activities that have float, and determines when the optimal time to perform the activity is based on similar resources associated with different activities. By optimizing these resources, project teams can level the amount of resources required on site (de la Garza 2006, and Clough et al. 2000).

Commodities are the outputs from all of the inputted resources. Commodities are considered the product in place beyond any rework that may have been necessary. When the commodity outputs are loaded into a schedule, commodities drawn from the bid items are associated with activities that will be completed by the contractor. Some examples of output resources and commodities include (but are not limited to):

- Concrete placed
- Bricks placed
- Piles driven
- Aggregate base placed
- Asphalt paved
- Excavated earthwork (Harris 2004)

The units assigned to commodities are usually tons of material or cubic yards, or some measurement of weight or volume.

Commodity-loaded schedules add detail to the planned schedule. By developing a baseline for the amount of commodities planned to be in place throughout the project, project teams can validate that the project is making sufficient progress. If not, management must determine the best way to return the project to its intended baseline. Developing a planned commodity-loaded schedule will be discussed more in depth in the following chapters.

Resource-loaded schedules have the primary benefit of having a baseline or an intended plan for what resources are needed on certain days. In the case of commodity-loaded schedules, commodity baselines establish the progress that should be made at different points during the project. Setting up a baseline schedule by loading the schedule with resources and commodities will be the setup for having a schedule that can be tracked. Having a baseline or having a plan established before performing the work will allow the project team to track the intended progress throughout the duration of the project. Tracking the schedule will confirm how well or how poorly the project is performing based on time, costs, and performance based on the commodities in place.

There have been many advances within the construction industry for planning construction projects. Schedule planning and control are important to construction and project managers with the inclination to keep the project within the schedule constraints. Effective project management can only come from control techniques utilized by the parties involved (Kerzner 2004). There are several aspects

of a project schedule that are exploited in order to control a schedule and maintain that the project goes according to plan, and techniques to bring to light when the schedule is not performing to the expected potential in regards to the schedule and the budget. One such practice is making use of commodity-loaded schedules. Commodity-loaded schedules are used as a tool to identify if the project is on track with the planned performance by comparing it to the actual performance.

Knowing that a project is making poor progress in earlier stages will give the project team a greater probability of getting the project back on schedule and finished within the projected completion date. Traditionally, tracking progress is performed by tracking the overall project budget versus the actual cost. This method is considered to be tracking the project at a macro level. Another common tracking tool is the Earned Value Method. This method integrates the tracking of the overall planned and actual project costs and the planned versus actual schedule. These values are used to determine the progress of the overall project. Both methods visualize this data by plotting S-curves to compare the costs over time, since costs are considered the most important commodity. These curves are important tools for comparing the planned costs, the actual costs, and the earned value of the project. This helps to forecast the schedule to predict the outcome of the overall project. It goes beyond comparing the as-planned schedule with the as-built schedule by comparing the current costs with the budgeted costs. The principle for controlling and tracking the schedule are apparent for determining schedule overruns and delays in specific points in the project, as well as the general project. This proves that identifying these trouble spots earlier can help people get the project back to a steady state before the project is beyond reasonable control (Bent 1996, Callahan 1992, Pilcher 1985, Westney 1985).

Parties involved in construction projects are more inclined to track only cash flows and costs incurred over time during the project to determine the status of the project. Tracking costs is an excellent way for determining how well the project is doing overall, but not individual aspects of the project. Companies must go beyond tracking the overall project progress, and focusing on other commodities in order to determine what aspects of the project are going wrong. This goes back to the point that the greater the detail that is placed on the schedule, the easier it will be to manage the project and determine how well it is going at a specific point during the project. Focus must also be made on the project and parts of the project, or amount of material in place (i.e. tons of aggregate base placed, cubic yards of concrete poured, etc.) to track the progress of a project. This will aid project teams in determining where troubleshooting should focus in order to bring the project within the projected budget and anticipated schedule timeframe based on the project scope (Anderson 2007).

This project & report will help the user understand the method of commodity tracking for progress control. By utilizing commodity curves, users will be able to track the progress of the project by comparing expected progress of individual bid items with their actual progress during certain time intervals. By tracking specific commodities, project teams will catch problems earlier in the construction process that could lead to unrecoverable delays and project failures. The earlier that problems are noted,

the easier it will be to manage the project back to success before it becomes more of a rescue effort from a progress standpoint.

This project & report will demonstrate that baseline schedules, commodity loaded schedules, and tracking progress methods will benefit construction projects through an example and a case study. Upon successful completion of this manual, the reader will be able to:

- Select commodities for tracking project progress
- Create baseline commodity curves based on the planned schedule
- Develop pro forma invoice requests for each pay period
- Develop progress curves to monitor and evaluate project progress by comparing the as-planned versus as-built commodity curves

This project & report encourages the use of these methods as a productive tool for increasing the probability of overall project success. The tracking of planned versus actual contract value is utilized quite often, but the industry must develop this method a step further. By focusing the efforts on tracking the commodities, projects can be monitored much more effectively.

In order to illustrate monitoring these commodities throughout the lifecycle of a project, this project & report will utilize effective schedule and design plans by creating these commodity loaded schedules and pro forma pay requests. This will be used to create baseline commodity curves in conjunction with the baseline schedules. This project & report will also demonstrate how projects can be monitored and tracked through the development of commodity curves at the end of each predetermined time period. Commodity curves can be used to track and report on the specific commodities as the project is constructed by comparing the planned progress versus the actual progress.

This project & report also introduces a new method for tracking the plan progress of a project. The Plan Performance Index measures how well the plan is being implemented based on the Budgeted Cost of Work Performed at different periods during the project. This method promotes not giving credit for work completed ahead of schedule unless all of the planned work has been completed at that point in time.

The examples utilized to demonstrate how to track commodities will be limited to two transportation projects. One is an example from *Construction Project Management* (Clough et al. 2000), which includes a classic and comprehensive example project entitled “The Highway Bridge Project”. This example is well-known and respected in the construction industry as an excellent sample project for educational purposes. This example will be expanded in order to demonstrate tracking commodities within a construction project.

Another example utilized to illustrate commodity tracking will be a more complex case study that was a project designed by the Virginia Department of Transportation and administered by the Town of Blacksburg. This project was a transportation project that involved converting an existing signal controlled intersection into a highway interchange.

The demonstration of tracking of schedules will be done by establishing a baseline commodity-loaded schedule and utilizing commodity curves for the *Construction Project Management* (Clough et al. 2000) example project. To further demonstrate these methods, this project & report will draw on a project designed by the Virginia Department of Transportation (VDOT) project that was administered by the Town of Blacksburg, the Tom's Creek Interchange project near Virginia Tech's campus. This will be the background for using commodity-loaded schedules in a real-life, more complex demonstration of the commodity curves, pro forma pay requests, and tracking project progress in an increasingly focused fashion.

The purpose of this project & report is not to discover the latest and greatest project control method. In fact, some companies already take advantage of the methodologies discussed in this project & report. Nonetheless, these methods are not commonplace within the construction industry, arguably due to the reluctance to be innovative (Rogers 2003). This project & report will expand on a traditional tracking method by adding another level of detail in order to focus the tracking efforts during the construction phase.

An Analogy for Planning and Tracking Commodities

Imagine that a person wishes to travel across the country from coast to coast. One does not simply embark on such a drive without making the appropriate preparations. A person would be very foolish to jump into their car with no knowledge of how they are going to get to such a distant destination. The driver could use the signs on the freeway to guide them to their destination, but it will probably take them much longer to get there. They would have no idea what the best route would be, nor where traffic could be. Before departing on such a journey, one would most likely prepare for it by determining the best route between destinations. If they foresaw the traffic problems that could occur, they may research where this would most likely be a problem, and change their route accordingly and avoid delays. A trip from coast to coast would not occur in one day, so planning for places to eat, sleep, and fill up their car on gasoline along their intended route would also be wise. These things are not free, so planning to have enough cash on hand for the trip would be yet another prudent decision. If someone wanted to know if they were going to have enough money for the rest of the trip, they would determine how much money they should have at specific time intervals. The amount of planning that occurs before departing on the journey, the more likely that the driver will make it within the desired travel time, and with enough money to complete the journey.

This situation is not unlike a construction project. Before the construction of any project takes place, the project management team must make the appropriate preparations by planning for this construction. They have to establish how much progress must be made at various intervals during the construction phase. The level of detail that is chosen for planning different aspects of the project will invariably be the level that the team can manage, track, and control the project.

Returning to the example of the cross-country road trip, imagine that sometime during the trip, the car breaks down. Without looking under the vehicle, the driver knows that there is a major problem with the car. It is one thing to know that the car has broken down, and another to know why the car is inoperable. Checking around the vehicle, the driver notices that steam is rising out of the hood of his car. Now there is a good inclination as to why the car is not functioning: it is most likely due to the engine overheating. Even though the cause of the problem has been identified, this is all in vain, as the problem has already caused the car to break now. Looking back at this situation, the driver could evaluate the lessons learned from what has happened. If the driver had been studying his gauges periodically, they may have been able to repair the car before it broke down by adding engine coolant or to have a mechanic fix the car.

Once again, the driver's situation can be related to a construction project. Through the use of the Earned Value Method, it can easily be seen that there is a problem with the way the project is going. Project teams can use the Schedule Performance Index to determine if the project is going as expected. Unfortunately, the drawback to this is that a problem has been identified with the project, but it cannot be determined exactly where the problem lies. If specific commodities are tracked within our project, they

can be broken down into their respective activities during the planning phase. This is the foundation for the tracking commodities because this will help determine the health of various aspects of the project. This is not unlike the driver in the analogy if they frequently check their dashboard gauges, such as the temperature and gasoline gauge, and warning lights for catching problems before they can create a larger predicament. Project teams must determine the progress of individual commodities to ensure that they are on schedule with the planned baseline to ensure that the project will be completed in a timely fashion overall.

Traditional Progress Tracking

The construction industry has implemented a way to determine how well a project is performing based on established criteria associated with the as-planned and as-built schedules. The industry focuses on the costs associated with the project by establishing a baseline to determine how much different aspects of a project should cost, and compares them to how much it actually cost to do certain activities associated with the construction project. This shows the long-time belief that cost is considered as the ultimate commodity. Besides having a fully-functioning product meeting the expected quality standards set by the owner, the chief factor for determining if the project has been a success is if there has been a profit with minimal liquidated damages, cost overruns, and schedule delays.

The basis for displaying the progress of a project, the as-built schedule, and comparing that progress to the planned schedule, is through a cumulative plot of the progress over time. This progress versus time plot is commonly known as an S-curve or a progress curve. Figure 2 demonstrates an example of a simple progress curve used to plot the amount of money expended, or the quantity or work done, over a predetermined amount of time.

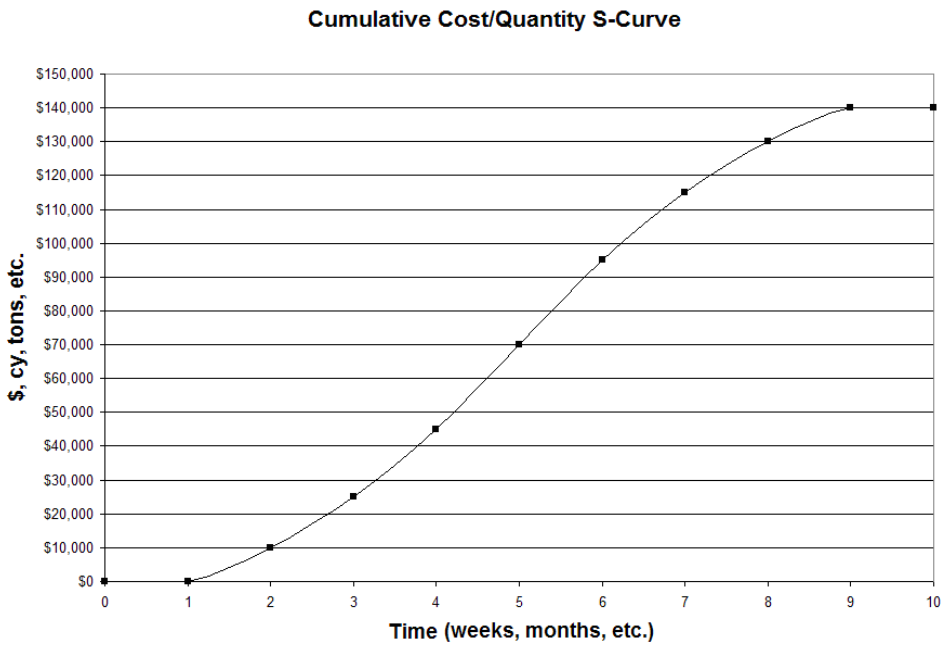


Figure 2: Typical S-Curve

The basis of any progress tracking method comes down to comparing planned progress to the actual progress. By tracking and continually updating the actual progress to compare with the intended progress at a set point in time, project management teams can determine if the actual progress is meeting or exceeding the planned progress. If the team discovers that the actual progress is below the

planned progress at any point in time, the appropriate action must be taken to return the project to its intended course. It is important that the actual progress remain below or equivalent to the planned progress (assuming the project schedule is not delayed) throughout the construction of the project. When two S-curves are plotted against each other for comparison purposes, they can be referred to as SS-curves (Barraza 2000).

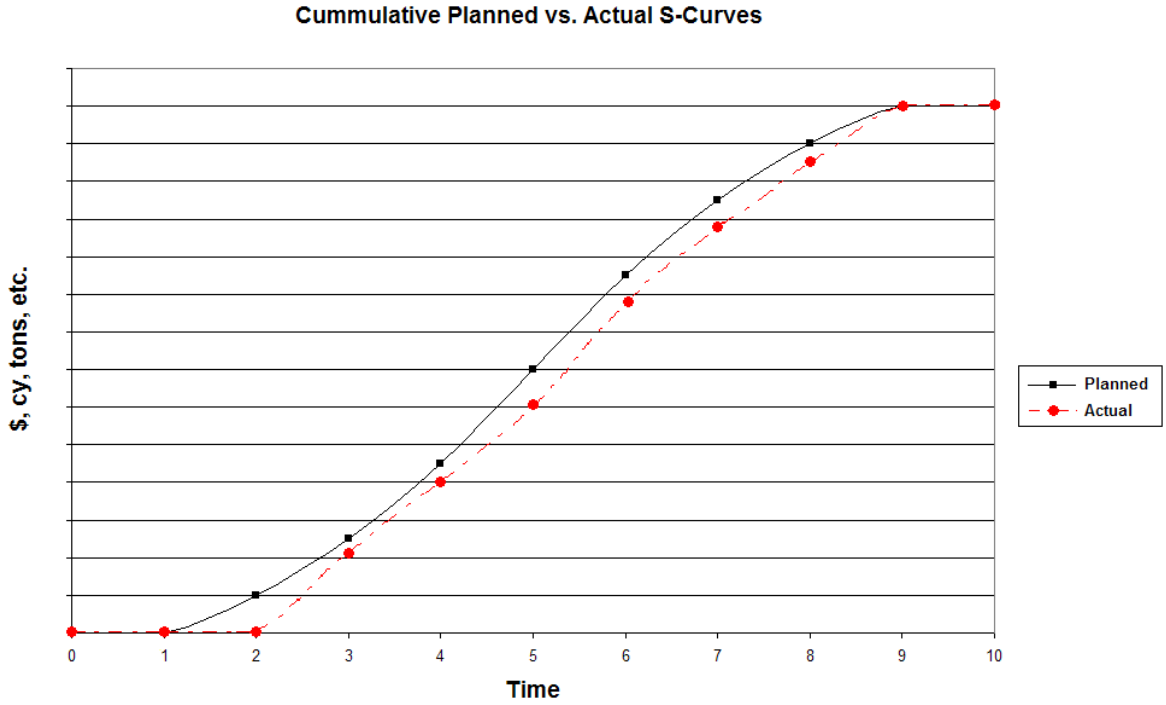


Figure 3: Typical As-Planned versus As-Built S-Curve

The principle behind plotting planned and actual cost and schedule values for tracking purposes is to catch major deviations from the intended cost and planned schedule progress at the predetermined increments. If project teams catch these variations earlier in the construction process, they can not only increase the probability of getting back on the intended track, but also evaluate why the progress was delayed initially. By finding the reason for overruns and delays earlier in the process, the project team can ensure that the problem does not occur repetitively, especially if it is an activity that will occur several times over the course of construction. Uncovering these cost and schedule variations earlier in the project is in the best interest of the project team because the later in the project they determine a variation, the higher the necessary productivity will have to be to complete the project on time (Adrian 1976).

Tracking data by comparing planned costs and actual costs, as well as having a planned schedule and an updated actual schedule, is a rather inconclusive tracking process for determining the progress of a construction project. Comparing the planned and actual values during the project does not

include information on the progress that has been made (Al-Jibouri 2003). For instance, a contractor may have planned to spend $100 in a week that $120 was spent. At first glance, it would appear that the contractor should be ahead because they spent more than they planned to spend. What if in reality that contractor had only completed 80% of the work that week? In this case, that contractor actually spent $120 to complete 80% of the work that was planned to be worth $100. The contractor only *earned* $80. The actual value is what was spent overall, and the earned value is the amount expended in relation to the amount of work that was completed.

The tracking of a construction project through the integration of cost and schedule monitoring became possible through a method know as the Earned Value Method. This method is one of the functions outlined in the Cost/Schedule Control System, a guideline implemented by the Department of Defense (DoD) during the 1950's. The Earned Value Method was developed and implemented by the DoD due to the material shortages post-World War II (Webb 2003). On the transportation side, budgets became increasingly tighter while construction and maintenance costs soared. Several DOT's across the US began to follow suit with the DoD by using the Earned Value Method to measure project progress. The pioneering of the Earned Value Method by the DoD and DOT's helped establish it as a common implement for keeping a project within the projected schedule constraints while maintaining the required level of quality as established by the customer (Turner 1981).

The Earned Value Method has several purposes and benefits designed to track costs and determine how well the project is progressing based on the schedule. The DoD recognized that their projects could be planned to a level of detail that would illustrate the expected progress are certain stages during the construction project. By tracking the progress, they could get a sense of how the project was doing at specific times during the project.

The purpose of tracking actual costs versus the original budget through the Earned Value Method is to determine if a project is going as-planned based on the intended costs and schedule at any point chosen during the construction phase. The earlier that the project is determined to be off track, whether it be due to cost overruns or a schedule variance, the easier it will be for the project team to allocate the project resources and personnel to get the project where it should be.

Progress curves are traditionally used to visually display progression over the life of a project at predetermined time intervals. Using progress curves is important as a tool for comparing the planned costs, the actual costs, and the earned value. In combination, these plots help determine the current status of the project, and can be used to forecast the future progress throughout the remainder of the project, thus increasing the probability that the project will have a positive outcome. It goes beyond comparing the as-planned schedule with the as-built schedule by predicting and comparing the current costs and determining the earned value through the integration of cost and schedule tracking. (Bent 1996, Callahan 1992, Pilcher 1985, Westney 1985).

The Cost/Schedule Control Systems Criteria clarifies elements of the Earned Value Method that can be tracked throughout the project. They include:

- *Budgeted Cost of Work Scheduled (BCWS)*: This is the planned costs for work items or commodities being tracked. This is what it should cost to do what needs to be completed.
- *Actual Cost of Work Performed (ACWP)*: Actual cost for completed work items, including completed work items in progress. This is what the specific work items or commodities or overall costs for what has been completed as a specific point within the project.
- *Budgeted Cost of Work Performed (BCWP) or the Earned Value (EV)*: The planned cost for completed work items, including work items in progress. This is what it should have cost to do what has already been completed at a certain point within the project schedule.
- (Popescu 1995, and Webb 2003)

When discussing performance of a schedule to indicate how well the project is going, these general comparisons apply:

If BCWP > BCWS, then the project is ahead of schedule

If BCWP < BCWS, then the project is behind schedule.

If BCWP > ACWP, then the project is under budget.

If BCWP < ACWP, then the project is over budget.

One performance indicator derived from the Earned Value Method is the Schedule Performance Index (SPI). These indices determine how efficiently the project schedule is in regards to the project progression (Popescu 1995). The Schedule Performance Index, using the Earned Value Method, is calculated as follows:

$$SPI = \frac{BCWP}{BCWS}$$

The SPI can be plotted comparatively with time, with time being on the x-axis. A value of SPI greater than or equal to 1 affirms that the project is in a positive condition based on the progress of the scheduled commodities or the overall project progress. In contrast, an SPI that is less than 1 confirms that the contrary is factual.

Another method for enumerating progress using the Earned Value Method is through variance equations. This value determines how far off the intended progress is in comparison to the original as-planned schedule. The equation for Schedule Variance is:

SV = BCWP – BCWS (units: dollars or time)

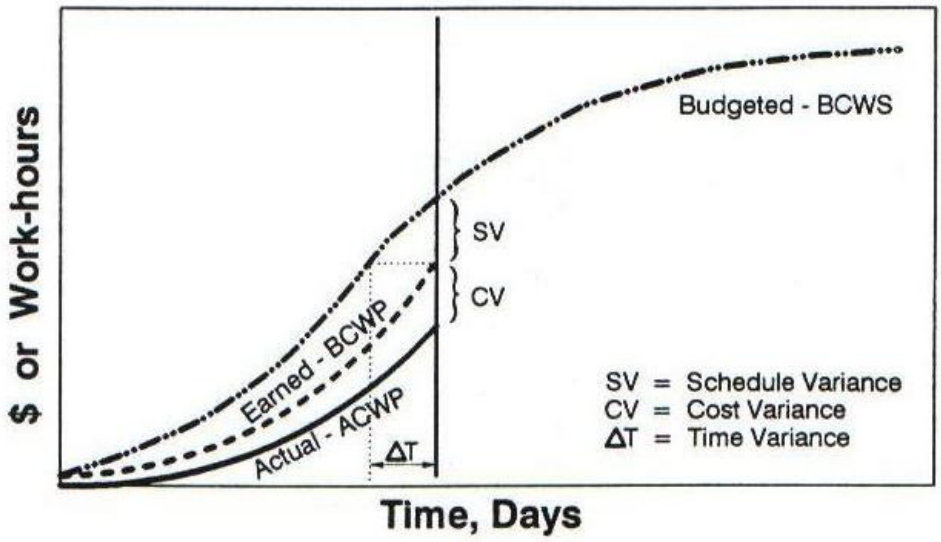


Figure 4: Relationship between Components of the Earned Value Method (Bent 1996)

In summary, the Earned Value Method has been implemented as a common method for determining the status of a project overall. By establishing baselines and updating on progress, the Earned Value Method can quantify the progress made at given intervals to determine how well or poorly the project is going. Utilization of the Earned Value Method is an important tool for monitoring and tracking progress of the overall project throughout the construction phase.

Commodity Planning & Scheduling

As previously mentioned in the introduction of this document, the level of planning and detail incorporated into the schedule determines the amount of control project teams will have over the construction project (de la Garza 2006, Westney 1985). This mantra can be applied to the idea of tracking commodities. If the project team chooses to track commodities, they take their planned schedule and add an extra level of detail to it. This added element will increase the ability to maintain the progress according to the as-planned schedule as well as possible. The focal point for discussion on commodity planning and scheduling will be establishing a commodity-loaded schedule to track construction progress to a greater depth than only tracking the overall financial expenditures over the duration of the project.

Inversely, there are consequences for not identifying commodities, their quantities, and which activities they relate to. It becomes difficult to keep track of the progress to determine if the project is on time or within the budget, which could lead to cost overruns and unwanted delays. If project teams do not establish a baseline for commodity progress, and choose not to track those commodities in conjunction with the overall costs, then they do not have a level of detail sufficient for determining where problems could occur, or are occurring, if it becomes apparent that sufficient progress is not being made.

To demonstrate how commodities are established in the plan and schedule of a construction project, the *Construction Project Management* (Clough et al. 2000) example project will be utilized throughout this chapter, as well as the chapters on Monitoring and Tracking and Reporting.

There are two main documents required to establish a commodity baseline, namely the design drawings and the bid documents for the project. The design drawings are the most comprehensive reference for defining the expectations for the project. These design documents often include detailed quantity takeoffs for many of the commodities associated with the project. Sometimes these are broken down into more detail by specifying the quantities of commodities for different components of the project. If these quantities are not summarized into a table, they can be found from the actual drawing specifications.

Figure 5 is a profile of the example bridge project. Because of the simplicity of this example, it does not have many of the design details that an actual bridge project would have. The purpose of displaying it here is to help visualize the example when developing a commodity-loaded schedule.

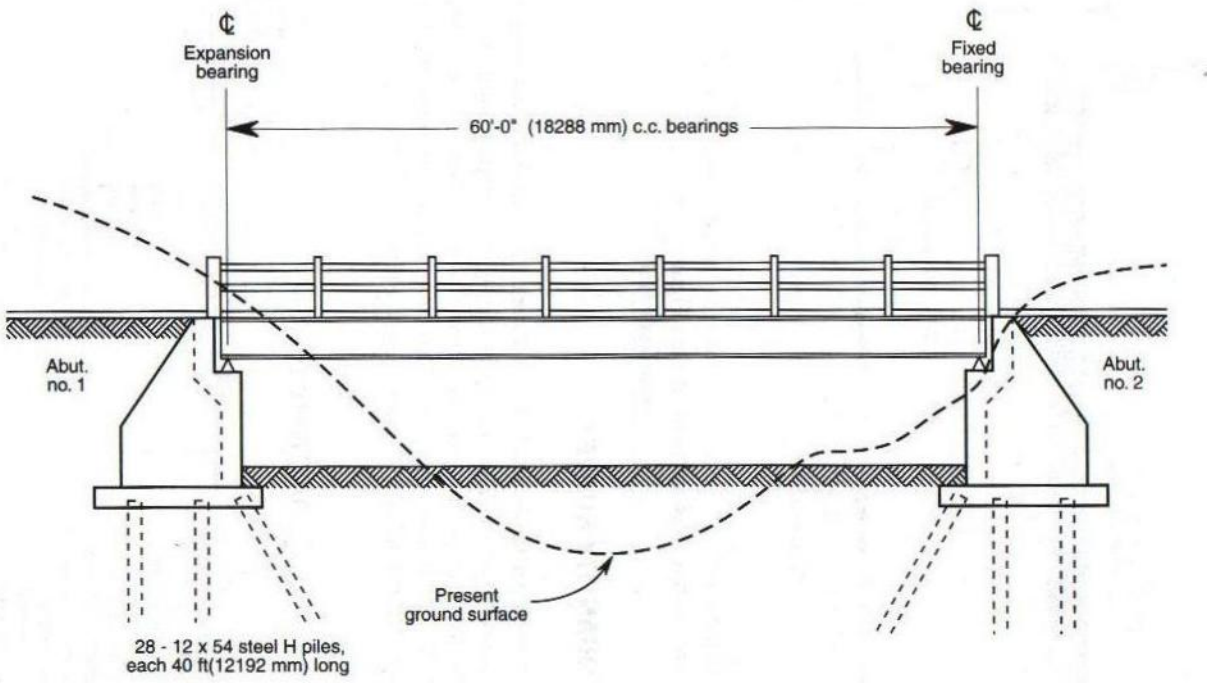


Figure 5: Highway Bridge Profile (Clough et al. 2000)

A list of bid items is also necessary for creating the commodity baseline. The bid items are part of the bid package that a contractor receives when a call for bids is advertised. The bid items should have a breakdown of different commodities, and their expected quantities are broken down for different locations in the design drawings. The quantities for each of these bid items should be associated for different activities during the construction planning phase. The commodities can then be loaded into the schedule. Each of the commodity quantities and their respective activities establishes each of the commodity baselines throughout the project.

Table 1 is a breakdown of the quantities, their unit price value, the total price, and the total contract value of the example project.

Table 1: Highway Bridge Bid Items

Highway Bride Bid Items

Description	Commodity	Total Quantity Planned	Unit	Unit Price	Total Price
Excavation, unclassified	Soil	1,667	cy	$4.83	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	$80,640.00
Steel, structural	Girders	65,500	lb	$0.892	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	$6,944.00
Guardrail	Rail	120	lf	$85.02	$10,202.40
Paint	Paint	1	ls	$10,814.60	$10,814.60
				CONTRACT VALUE	**$426,286.01**

Now that the value of having detailed drawings and bid items for developing a commodity-loaded schedule has been established, there is one more piece of information vital to creating a commodity-loaded schedule. The last requirement is the contractor's detailed construction schedule. This last piece of information will govern when specific activities will occur, how long they will last, and the critical activities that must be completed within the specified time in order for the entire project to be completed before the intended date.

Typically, commodity baselines could be based on both the early start and late start schedules. The early start date of an activity is the earliest date the activity can begin based on the activities preceding it. The late start is the absolute last date to start an activity without delaying activities on the critical path based on the original plan. If activities are delayed on the critical path, the overall project completion date will be delayed. If this should occur, the project team would have to accelerate the completion of activities to ensure the project schedule returns to its intended progress so the entire project is completed on time.

Activities should be completed somewhere between the early start and late start. A project is not delayed until the performance falls behind the late start schedule. If activities are completed closer to the late start, project teams will have a much harder time completing the work when there is less float or no float available to make up for lost time. The likelihood of bringing a project that is delayed back up to speed is greater when activities are completed closer to the early start dates. This project & report will focus on the early start schedules to encourage those who use this as a guideline for tracking commodities to do the same.

Figure 6 is an early-start bar chart schedule displaying the activities associated with the project. It should be noted that critical activities are in red, while activities with float are in green. "PWD" is an acronym for planned working days.

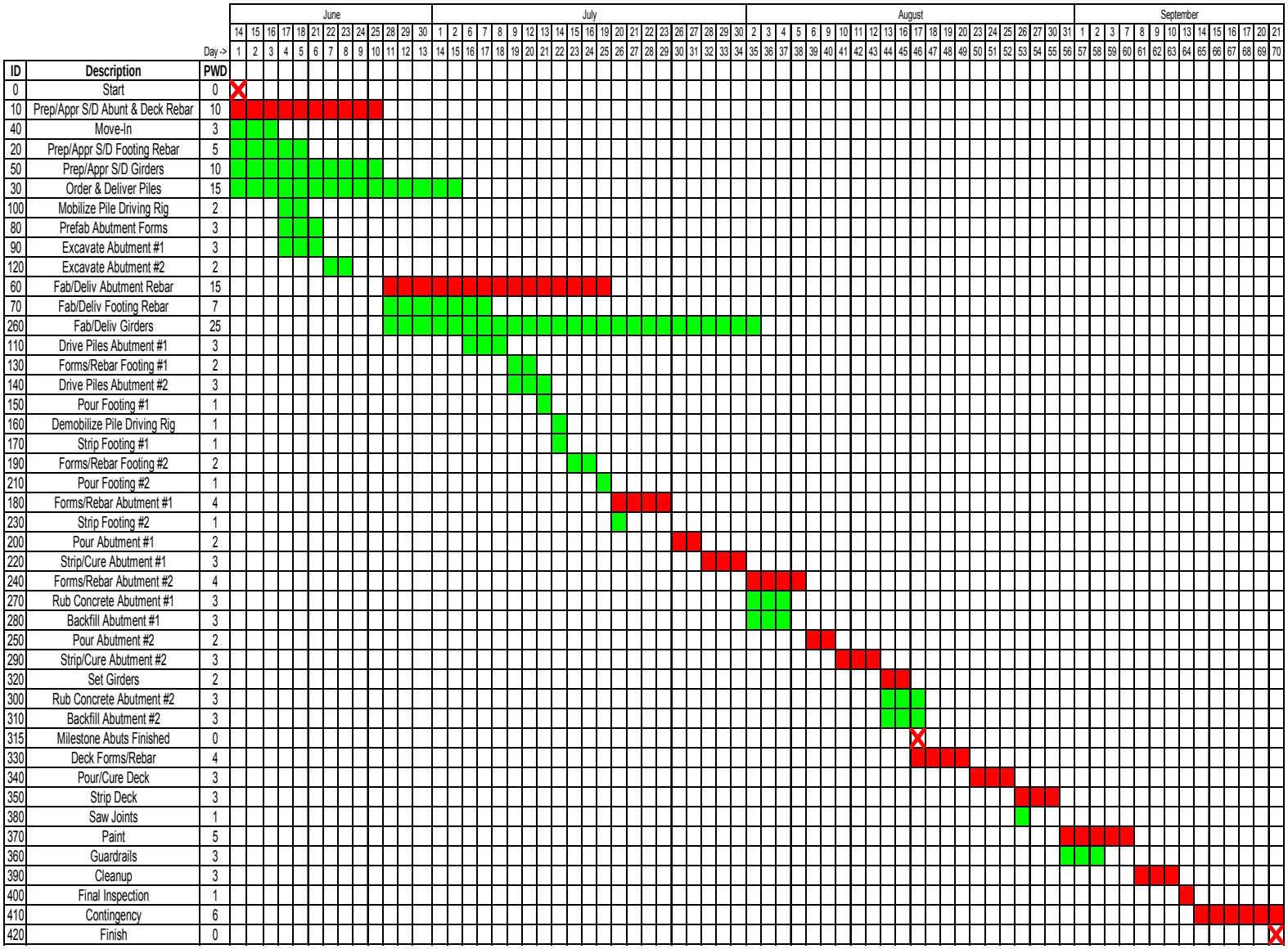


Figure 6: Highway Bridge Early Start Schedule

The next step for creating a commodity baseline is to determine which commodities should be tracked. There are several guidelines for determining which commodities are the best ones to track. The guideline for selecting commodities to track include:

- Commodities span 30% of the project
- Each commodity is involved with multiple activities
- Commodities are associated with the critical path
- If several commodities are related to each other, select one
- Commodities associated with high-visibility or high-risk activities

Following these guidelines for selecting commodities to track is important when developing baseline commodity curves. One of the guidelines involves commodities that are related to multiple activities. Commodities that only span a short duration of the project are probably not worth tracking. A commodity that is associated with several activities is more likely to cover more time slices than a commodity that is only associated with one activity.

Since the length of time that the commodity spans the project is important when selecting commodities to track, another guideline focuses on what is an appropriate time span for a commodity to be selected for tracking purposes. Preferably, for a commodity to meet the criteria of being worth tracking, it should span through at least 30% of the project. The greater the duration a commodity can be tracked within a project, the more opportunities the commodity can be tracked to determine how well it is progressing.

Commodities associated with activities along the critical path of the project should also be considered for tracking. The activities and their respected commodities that are along the critical path must be completed within the appropriate planned timeframe to ensure the overall project finishes on time. Tracking these commodities would be beneficial because they are vital to the overall construction of the project. Commodities that are productivity critical usually fall under activities along the critical path, and should be considered for tracking purposes.

Throughout the construction process, there are several activities that can be related to each other in the sequence of activities. For a project that requires reinforced concrete, rebar must be placed before the concrete is poured. Since the progress of concrete placement is based heavily on the productivity associated with the placement of rebar, project teams do not have to track both commodities. If the team chooses to track one of these commodities related to the other, they would probably be able to infer on the progress of both just by tracking one of them. Selection of which commodity to track in this instance largely depends on whether the project team wishes to know the progress of commodities as early as possible, or would rather track them closer to their intended completion.

In some cases, not every commodity that meets the criteria set by the guideline needs to be tracked. For the construction of a road, the contractor would have to excavate the soil and place aggregate base before paving the road with the asphalt. It would be best to track the aggregate base

over the excavation, because it occurs later than the excavation. It is also possible to choose to track the excavation because there may be multiple roads and ramps and other activities associated with this commodity, so it may be better to track both excavation and aggregate base. Paving asphalt would not be a preferable commodity to track, since it usually occurs over a shorter time period relative to the entire project.

A construction project has many activities and commodities throughout, and depending on the size of the project, selecting just one commodity may not give the level of detail necessary to effectively track progress. There may be one commodity that spans a majority of the project, but that commodity may only deal with a small amount of the overall construction work. Selecting multiple commodities to track helps to focus on more than one aspect of the project. This greater level of detail will maximize the effectiveness of tracking commodities, and also enables the project to be controlled and managed more effectively.

Commodities associated with activities that are considered highly visible or high-risk, where multiple outside agencies would be involved, should also be considered for tracking. For example, tunneling under a major roadway or blasting near an active gas line could be considered high-risk. Since all focus may be turned to this activity when it is performed, it is important to select the commodities associated with the work for tracking purposes.

Table 2 illustrates the breakdown of planned commodity quantities loaded into the Highway Bridge construction schedule. This will be used to help determine which commodities to track this project.

Table 2: Highway Bridge Commodity-Loaded Schedule Breakdown

Commodities Associated With Activities						
				Total Quantity		
ID	Description	PWD	Work Type	Commodity	Planned	Unit
0	Start	0				
10	Prep/Appr S/D Abunt & Deck Rebar	10				
40	Move-In	3				
20	Prep/Appr S/D Footing Rebar	5				
50	Prep/Appr S/D Girders	10				
30	Order & Deliver Piles	15				
100	Mobilize Pile Driving Rig	2				
80	Prefab Abutment Forms	3				
90	Excavate Abutment #1	3	Excavation, unclassified	Soil	1,000	cy
			Excavation, structural	Soil	72	cy
120	Excavate Abutment #2	2	Excavation, unclassified	Soil	667	cy
			Excavation, structural	Soil	48	cy
60	Fab/Deliv Abutment Rebar	15				
70	Fab/Deliv Footing Rebar	7				
260	Fab/Deliv Girders	25				
110	Drive Piles Abutment #1	3	Piling, steel, driving	Steel Piles	1,120	lf
130	Forms/Rebar Footing #1	2	Steel, reinforcing	Rebar	11,250	lb
140	Drive Piles Abutment #2	3	Piling, steel, driving	Steel Piles	1,120	lf
150	Pour Footing #1	1	Concrete, footings, place	Concrete	60	cy
160	Demobilize Pile Driving Rig	1				
170	Strip Footing #1	1				
190	Forms/Rebar Footing #2	2	Steel, reinforcing	Rebar	11,250	lb
210	Pour Footing #2	1	Concrete, footings, place	Concrete	60	cy
180	Forms/Rebar Abutment #1	4	Steel, reinforcing	Rebar	22,500	lb
230	Strip Footing #2	1				
200	Pour Abutment #1	2	Concrete, abutments, place	Concrete	140	cy
220	Strip/Cure Abutment #1	3				
240	Forms/Rebar Abutment #2	4	Steel, reinforcing	Rebar	22,500	lb
270	Rub Concrete Abutment #1	3				
280	Backfill Abutment #1	3	Backfill, compacted	Soil	170	cy
250	Pour Abutment #2	2	Concrete, abutments, place	Concrete	140	cy
290	Strip/Cure Abutment #2	3				
320	Set Girders	2	Steel, structural, place	Girders	65,000	lb
			Bearing plates	Plates	3,200	lb
300	Rub Concrete Abutment #2	3				
310	Backfill Abutment #2	3	Backfill, compacted	Soil	170	cy
315	Milestone Abuts Finished	0				
330	Deck Forms/Rebar	4	Steel, reinforcing	Rebar	22,500	lb
340	Pour/Cure Deck	3	Concrete, deck, place & screed	Concrete	56	cy
350	Strip Deck	3				
380	Saw Joints	1				
370	Paint	5	Paint	Paint	1	ls
360	Guardrails	3	Guardrail	Rail	120	lf
390	Cleanup	3				
400	Final Inspection	1				
410	Contingency	6				
420	Finish	0				

There are three commodities that occur during a majority of the overall project. Those commodities are rebar, concrete, and soil. It should be noted that for this example, concrete has been broken down into footing, abutment, and deck slab concrete, usually because these are different classes of concrete for each of these bridge sections. These three concrete types will be treated as one overall commodity for this example. The earthwork associated with excavation (both unclassified and structural) and backfill are also treated as one soil commodity within the Highway Bridge project. These three

commodities meet the criteria that has been set forth for commodities worth tracking. It should be noted that both rebar and concrete are commodities related to one another, since rebar is used to reinforce concrete. Given that this is the case, it would be redundant to track both of these commodities because their progress tends to be similar to each other. For the example project, the rebar will be tracked to determine earlier during construction if the project is making substantial completion every week.

From here, the number of progress updates must be determined. In other words, how often will the project team create milestones of when to evaluate the progress that is being made based on the comparing planned and actual commodities and contract value? Essentially, the schedule must be segmented into several equal periods, or "time slices", to determine when each milestone for monitoring progress will be made. These time slices would most likely occur on a monthly, semi-monthly, or weekly basis. Trying to track a schedule on a daily or hourly basis would not be cost-effective, nor worth the time and effort required to employ this level of detail.

A general guideline for determining the duration of each time slice would be to take the duration of the entire project, and create the time slices at 5 – 10% progress milestones (10 to 20 time slices) throughout the project. In the case of the project example, updates would occur every week. The Highway Bridge project spans across just over three months, so making the time slices weekly fits the 5 – 10% criteria. Figure 7 demonstrates these weekly time slices for the project. Note that a full work week consists of 5 working days since work will not occur on the weekends, and some work weeks are shorter due to holidays.

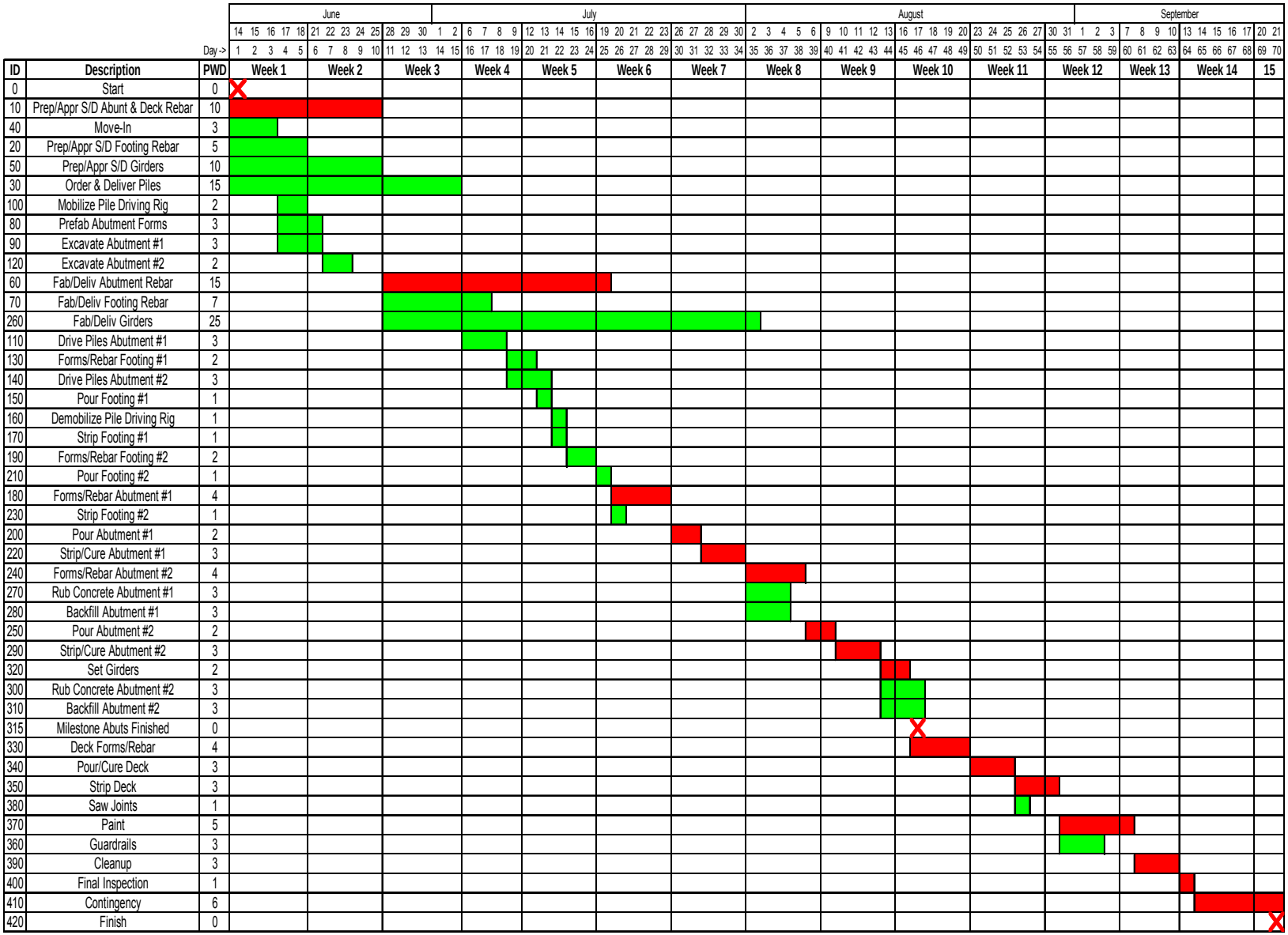


Figure 7: Highway Bridge Time Slices

Now that a guideline for establishing the time slices has been presented, the next focus for discussion will be on the standardization of displaying the anticipated, or "as-planned", commodity progress. Pro forma documents are often used in business as a balance sheet and income statement for projecting the outcome in the future from actions in the present. They are also used as a standard document to commitments for services to be provided in the future (Viscione 1980). In the instance of the example project, the contractor will create the pro forma pay requests from the baseline commodity-loaded schedule, breaking down the anticipated work progress based on the commodity quantities associated with each scheduled activity. Table 3 is a sample pro forma pay request from the example project. For the pro forma pay requests for each of the weekly time slices, refer to the appendix.

Table 3: Sample Pro Forma Pay Request

Pro Forma Pay Request **Week Ending August 20th (Project Week #10)** **Highway Bridge Project**								
Bid Items					Week 10 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	113	340	$1,922.13	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	22,500	90,000	$20,160.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	32,750	65,500	$29,213.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	1,600	3,200	$3,472.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$54,767.13**	$377,897.01

The established expectations of commodity progress ensures an added level of detailed planning because the contractor has not only communicated the expected value of the work they will perform during each of the time slices, but also the quantities of bid item commodities they intend to have completed during different periods within the entire project. With the baseline schedule and pro forma pay requests, the contractor will be able to determine if their actual progress is close to the intended progress based on the schedule that has been established.

Generating the commodity curves from the pro forma pay requests is the next step towards tracking commodities. The curves are based on the planned commodity baselines established through the commodity-loaded schedule detailed in the pro forma pay requests. The commodity curves act as a reference for visualizing the progress of specific commodities without having to read the details. Referring to a commodity curve would help to interpret the planned and actual commodity data, rather than reading through a detailed table to analyze the data. Commodity curves are intended to give an overview of progress through a graphical display of information (Kastellec 2006, Cleveland 1993).

Figure 8 and Figure 9 illustrate the planned progress of rebar and soil, the two commodities selected for tracking throughout the example project.

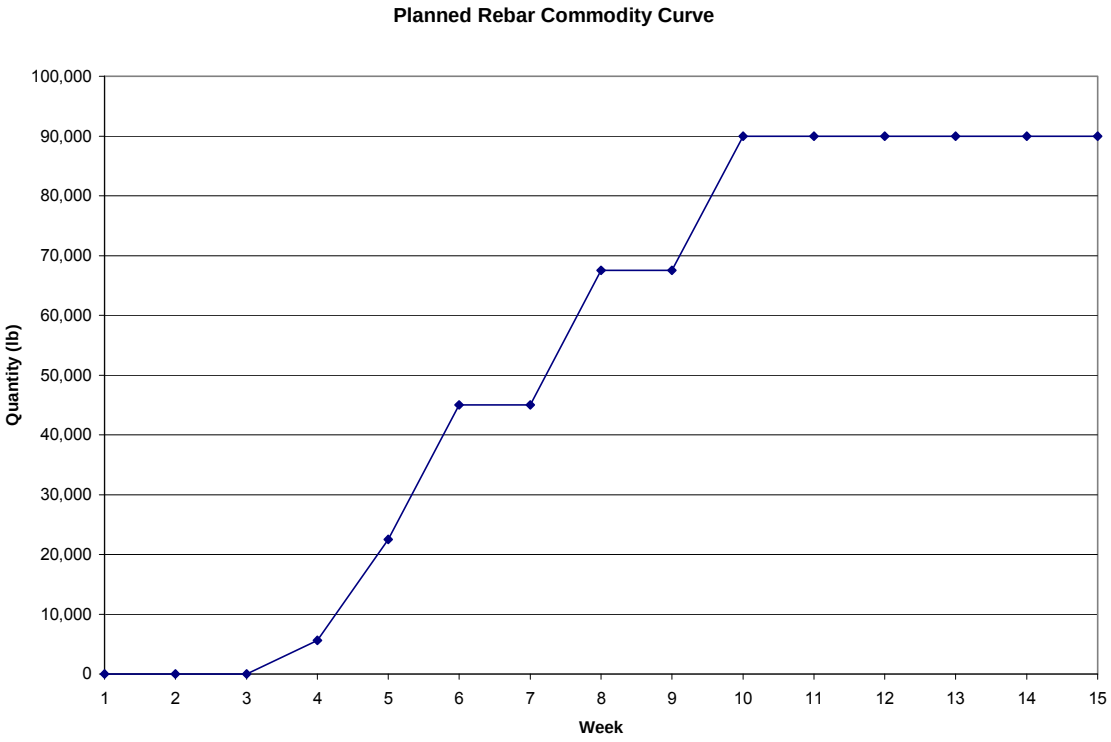


Figure 8: Commodity Curve for Planned Rebar Progress

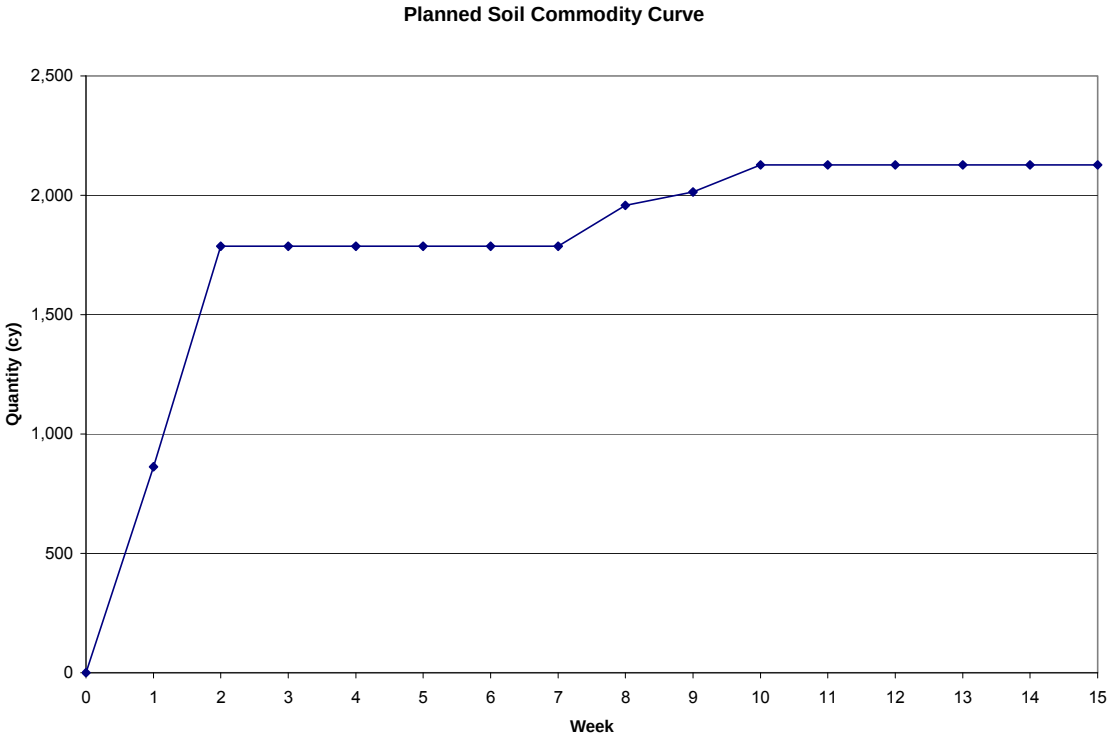


Figure 9: Commodity Curve for Planned Soil Progress

With the planned commodity curves established for each of the selected commodities, the planned commodity curves can be compared against the progress of the entire project. Figure 10 is a plot of the progress of the selected commodities, and the planned progress of the contract value in terms of the percent completed for each time slice.

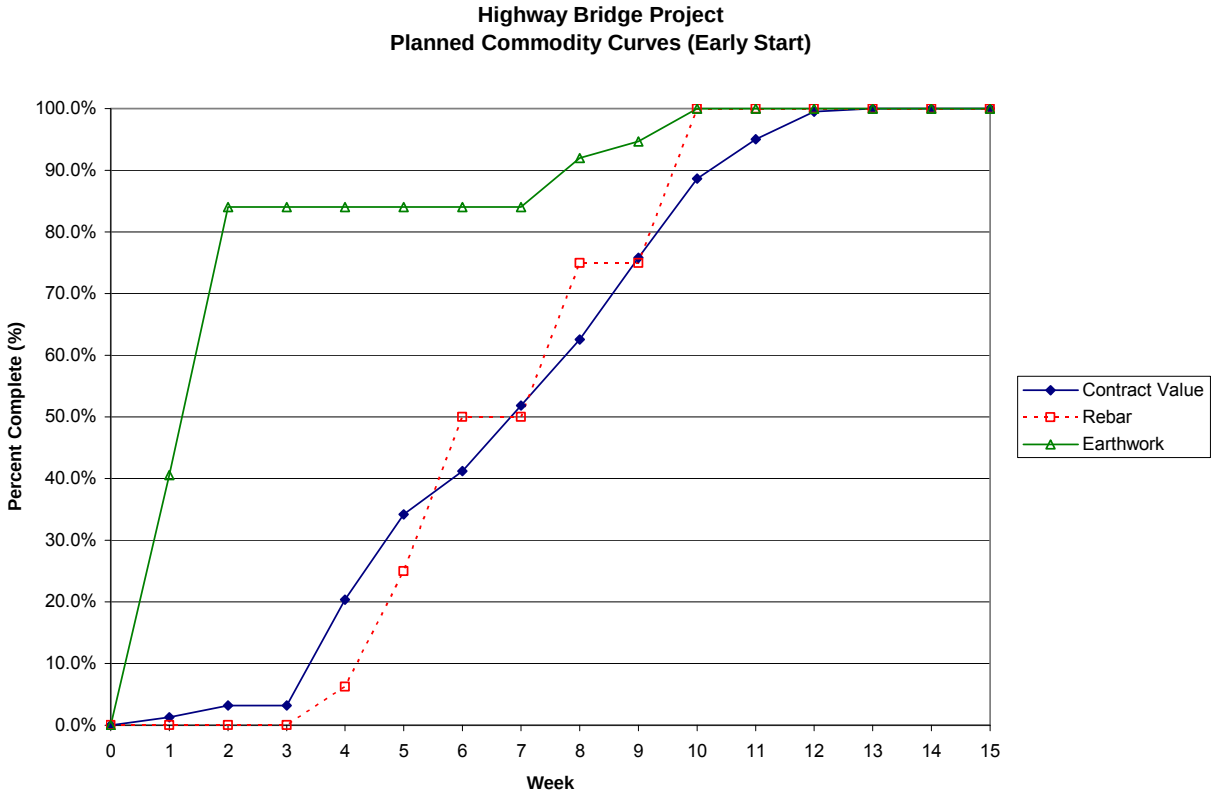


Figure 10: Comparison of the Commodity Curves Planned Progression

Establishing the baseline quantities for commodities during the planning phase is an important step towards determining the progress of commodities throughout the project. The foundation for tracking commodities is through the establishment of commodity baselines from the project schedule and bid documents. It is the first step towards adding another level of detail and focus for controlling a construction project by tracking the progress of individual commodities.

Commodity Monitoring

There is an adage that states that what gets measured gets improved or managed. In order for progress updates on commodities to be made throughout the project for tracking purposes, the construction project must be monitored effectively. This is done throughout the construction phase of the project through field observations. Monitoring progress is typically a standard practice during the construction phase. The project team must record the field data to determine where they stand as far as percentage of each activity completed, and the overall project as a whole. The field measurements are integral for the tracking and reporting stage, because tracking and reporting the planned progress against the earned progress is best accomplished through accurate data collection in the field (Arcuri 2007).

Monitoring construction progress can be done by collecting data from several sources. Usually the information is collected based on specific activities or work types (Al-Jibouri 2003). The information can be collected through the daily progress reports by foremen completing the work, or quality control personnel monitoring the work. The information collected should reflect reality through accurate data collection since the information collected in the field will be utilized during the tracking and reporting stage for evaluation of the progress at any given point during the project.

As stated previously, focusing on monitoring commodities for tracking purposes would add a level of detail for controlling the project. It would not take a great amount of effort to monitor specific commodities in conjunction with other systems being monitored. Since the monitoring of construction progress should already be taking place in the field, monitoring and collecting data for commodity progress should also be implemented.

The data collected during the monitoring phase is usually compared with the overall construction project progress during the tracking and reporting stage. If data is collected for commodity progress, not only will the overall construction progress be evaluated, but also commodities associated with several activities and work types can be tracked and evaluated. By monitoring the commodities, the added level of detail that has been emphasized throughout this project & report will be included in the tracking and reporting phase.

When a project falls behind its intended progress, the project team must make every effort to allocate resources to expedite the project where progress has fallen behind. The problem with just tracking the overall project is determining the exact resource allocation procedure. Tracking commodities would be important for determining the progress of the project in an increasingly focused fashion. By monitoring commodity progress accurately, selected commodities can be tracked against their baseline to reflect the reality of the project. Monitoring the progress of commodities is a vital step that bridges the gap between the planning and tracking phases of a construction project.

When monitoring a project, there are several ways to determine the value at the end of the predetermined period. Value can be based on the budget spent at that point. The shortfalls of this approach were discussed in Chapter 3. Just because an amount of money was spent on an activity does

not warrant that the amount expended was the amount earned for that work. Value can be estimated based on how much work it is thought to be completed at that point. This method is quite subjective, and is not very effective for tracking purposes. Value can also be based on the amount of time that has passed. This can also be considered subjective, since there may not be a real basis for determining how much progress has been made, especially if the schedule has not updated to reflect the amount of work completed. The most effective and accurate way for determining value is though the percent of work complete based on the quantity of material in place.

There is also a difference between taking value when an activity is done, and when it is completed. If an activity is done, this implies that the activity succeeding it is ready to begin. If an activity is complete, the outputs of that activity have been checked and accepted based on the Quality Control standards. Value should be taken when the activity and its commodities are completed.

Commodity Tracking & Reporting

Tracking contract value is a typical method for determining how well the project is doing. This project & report demonstrates how tracking commodities adds another level of detail to progress tracking. The added focus on a baseline commodity schedule and the commodity updates help determine how well the project is doing beyond tracking contract value. As mentioned previously, tracking contract value determines the progress of the overall project, but if progress should fall into an unfavorable condition, it could not be immediately determined why sufficient progress was not being made.

The commodity tracking & reporting phase should be done at the end of each time slice to ensure that progress updates are done on a regular basis. If a project takes a negative turn, the project team must identify the reason why the project is behind schedule as soon as possible. This will increase the probability that the project can be managed towards successful completion by allocating the proper resources where commodity progress is lagging.

Once again, the example project from *Construction Project Management* (Clough et al. 2000) will be used, this time to illustrate the tracking of commodities. Figure 11 shows the update of the earned and planned contract value.

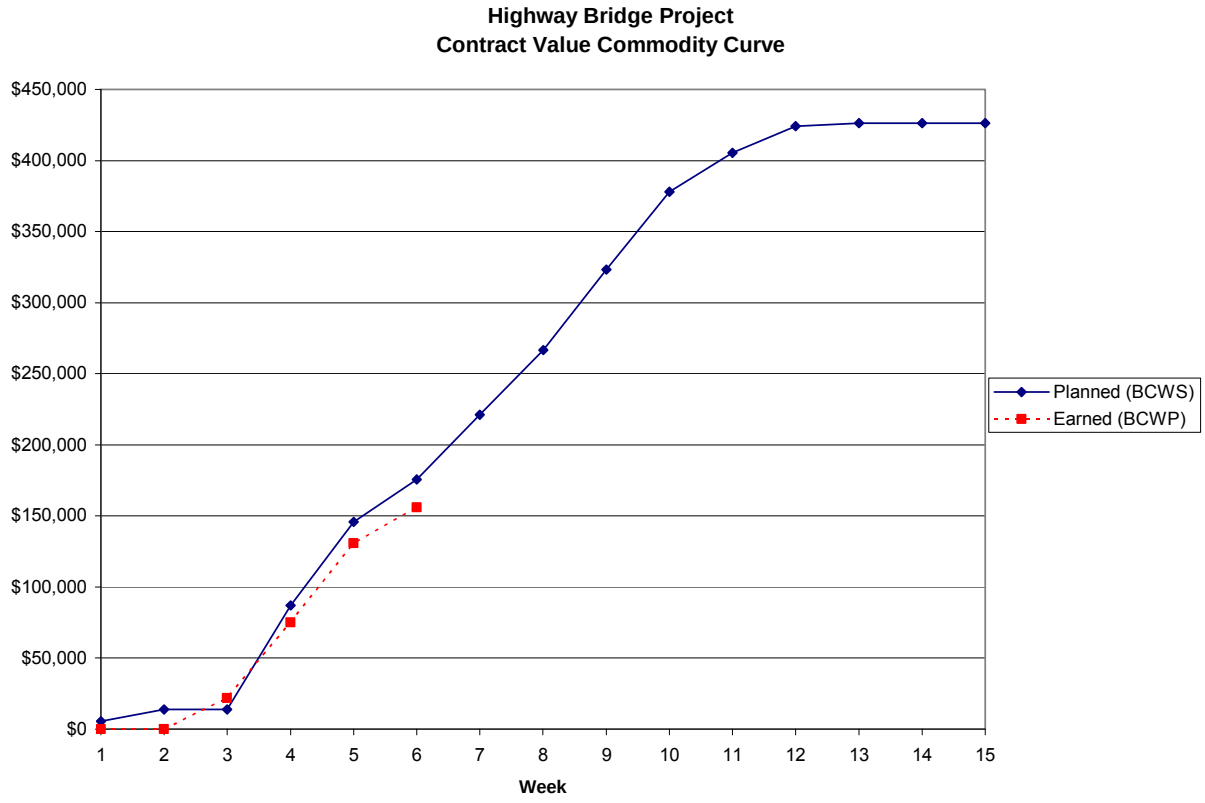


Figure 11: Highway Bridge Contract Value, Week 6

Using the performance metric from Chapter 3, it can determined that:

$$SPI = \frac{BCWP}{BCWS} = \frac{\$151{,}919.21}{\$175{,}703.61} = 0.89$$

A value below 1.0 indicates the project is behind. In this instance, the actual contract value indicates the project is behind 11%. Now the focus must be made as to where the schedule is not progressing. First, data on the progress of commodities must be analyzed. Table 4 shows the actual progress at the end of week 6.

Table 4: Highway Bridge Project Commodity Progress Report

Report on Commodity Progress Week Ending July 23rd (Project Week 6) Highway Bridge Project								
Bid Items					Week 10 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Earned Qty This Period	Earned Qty To Date	Earned Value This Period	Earned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	224	2,240	$10,227.84	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	60	$0.00	$9,704.40
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	16,875	33,750	$15,120.00	$30,240.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$25,347.84**	$155,919.21

The commodity curve for rebar will give an indication as to whether the progress of rebar is behind, also causing the project to be behind the planned progress. Figure 12 is the rebar commodity curve for week 6.

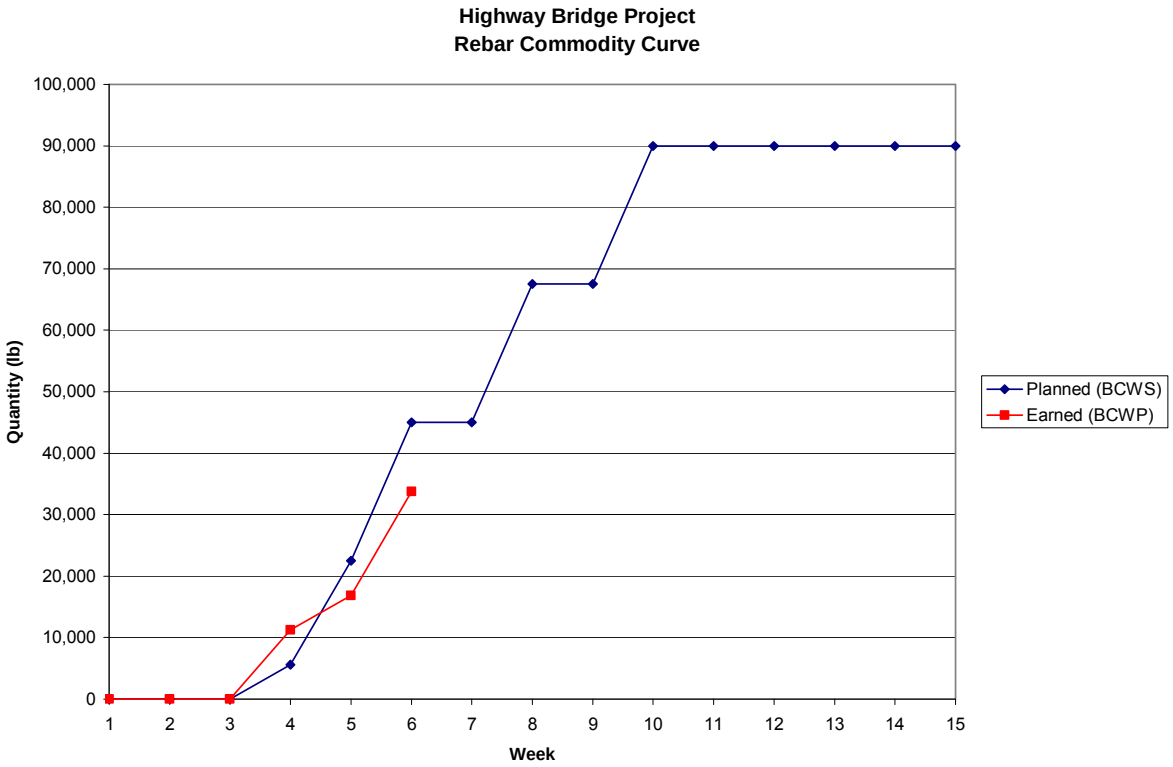


Figure 12: Commodity Curve for Rebar in Week 6

Using the metric for schedule performance, it can be determined that:

$$SPI = \frac{BCWP}{BCWS} = \frac{33{,}750}{45{,}000} = 0.75$$

Rebar is behind in this example by 25%. Since the rebar commodity is behind the planned baseline, it means that concrete is also behind schedule. Now that it has been established that concrete and rebar is not progressing as planned, the project team must focus their efforts on allocating the resources to return the rebar and concrete work back towards its intended progress before any more problems arise on this project.

So why has rebar fallen behind the planned progress? Figure 13 is the commodity curve for the soil commodity curve through week 6.

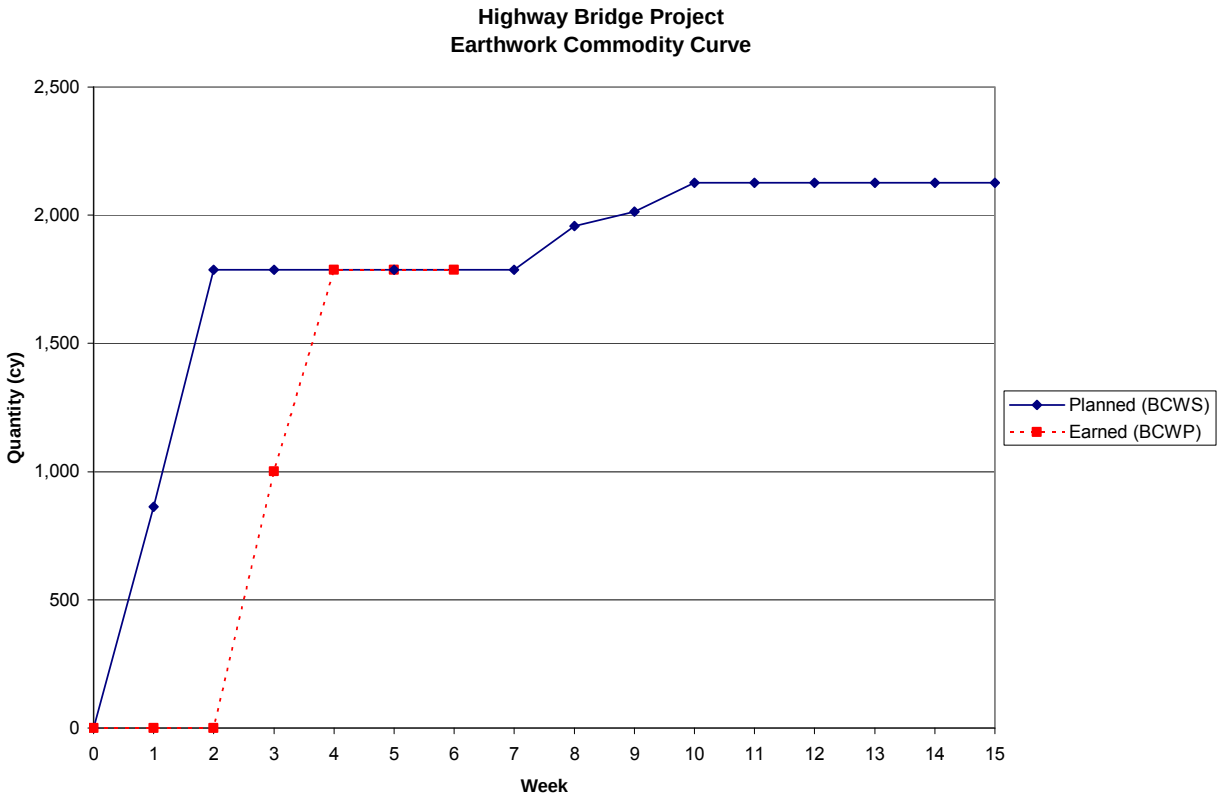


Figure 13: Earthwork Commodity Curve

According to this commodity curve, the earthwork is progressing as planned at this point, so the earthwork is not delaying rebar progress. Figure 14 is the as-planned vs. as-built schedule for the project. From this schedule, it can be determined that driving piles was delaying for an abutment, and this also delayed the rebar work. Referring to the *Construction Project Management* (Clough et al. 2000) example, the pile driver necessary for piling activities broke down during the example project to demonstrate unforeseen delays during a project.

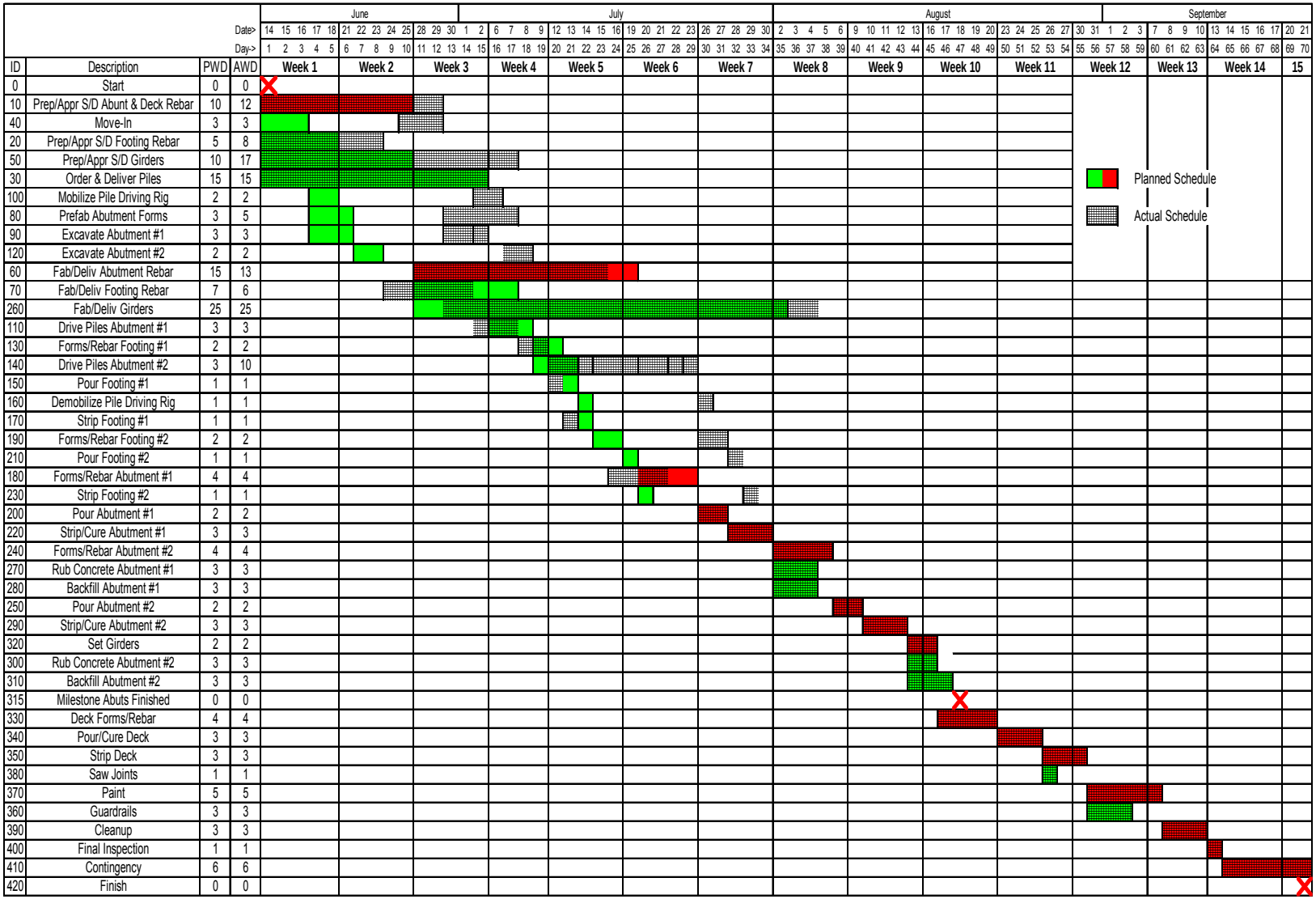


Figure 14: Highway Bridge As-Built Schedule

It is very likely that a construction project will not be performed according to the original planned schedule. Uncertainties and uniqueness associated with each project assures that not everything will go according to plan. Sometimes when work falls behind during some parts of the project, the work is shifted to parts of the project that can be performed, many times activities that are further ahead in the project schedule. Even though work continues on activities ahead of schedule, in spite of delays with activities that should be in progress, does not necessarily mean that construction is keeping pace towards the intended completion date. Construction may have activities and commodities completed and in-place ahead of schedule, but planned activities may still be falling behind planned progress. A tracking method must be implemented for determining what progress has been made in regards to planned commodities that have been completed, as well as the overall commodities completed, including commodities that are ahead of schedule.

A progress performance indicator for tracking commodities and determining the quantity that is ahead or behind the planned baseline must be implemented to determine how much of the scheduled work is actually being completed. The metric for determining this is known as the Plan Performance Index, or the PPI. The PPI is an extension of the Earned Value Method since it requires the BCWS and BCWP from the contract value and from the commodities selected for tracking. The quantity or percentage of progress that the contract value or commodity has been planned for being completed, and has also been completed at that point, is known as the Budgeted Cost of Scheduled Work Performed, or the BCSWP.

The PPI also determines how well the plan is being followed. If the PPI < SPI for several time periods, the schedule may need to be revised to reflect a new plan for the project. The plan must be evaluated if it is not being followed to determine why, whether the plan needs revising because it is not suitable at this point, or if the plan is just not being implemented properly. Either way, the PPI give an indication of this.

Once the values for the planned (BCWS), earned (BCWP), and planned completed (BCSWP) commodity quantities have been determined, several conclusions can be made:

- If *BCWS* = *BCWP* = *BCSWP*, then commodity is on target with the planned commodity baseline schedule.
- If *BCWS* = *BCSWP* and *BCWP* > *BCW,* then commodity is ahead of the planned commodity baseline schedule.
- If *BCWS* = *BCWP* and *BCSWP* < *BCWS,* then commodity is behind the planned commodity baseline schedule.
- If *BCSWP* < *BCWS* and *BCWP* < *BCWS*, then commodity is behind the planned commodity baseline schedule in multiple activities.
- If *BCSWP* < *BCWS* and *BCWP* > *BCWS,* then commodity is ahead overall but behind the planned commodity baseline schedule.

The purpose of determining the BCSWP is to show that being ahead in a commodity associated with an activity planned for completion further in the schedule does not mean the project is ahead overall because an activity associated with that commodity may not be on track with the baseline schedule. For instance, if *BCSWP* < *BCWS* and *BCWP* > *BCWS*, the commodity quantity may be ahead overall, but the planned quantity and the activities that were planned to be completed were not. If this is the case, focus should be placed on the planned commodity and the activities associated with it to ensure that this delay does not affect other activities and commodities further along in the schedule. BCSWP is important for determining how well the intended plan is going by shifting the focus away from activities and commodities that are ahead of the baseline and focus on those that have fallen behind.

Once these values have been determined, BCSWP should be plotted to compare it with the BCWP and the BCWS. The Plan Performance Index is used to determine how well a commodity's planned completion is performing in comparison to the baseline at any given point. The Plan Performance Index is computed as follows:

$$\text{PPI} = \frac{\text{BCSWP}}{\text{BCWS}}$$

If *PPI* = 1, the planned performance is on schedule. If PPI < 1, Planned Performance is behind schedule. Also note that the SPI is always greater than or equal to the PPI.

Refer back to Figure 13 for the as-planned versus as-built schedule for the example project. Note that the activities in color delineate the planned activity duration, and activities with the gridded pattern indicate the actual start dates, finish dates, and activity durations. The parts of the activities that are colored and have grid patterns are the overlapping of planned and actual activity durations.

For the actual contract value determined over the life of the example project, refer to the appendix for the progress report on weekly commodity quantities. Table 5 summarizes the weekly contract values through week 3.

Table 5: PPI Contract Value for the Highway Bridge Project through Week 3

Week	Contract Value		
	Planned (BCWS)	Earned (BCWP)	Planned Completed (BCSWP)
1	$5,437.01	$0.00	$0.00
2	$13,696.41	$0.00	$0.00
3	$13,696.41	$21,862.15	$4,830.97
4	$86,906.79		
5	$145,839.21		
6	$175,703.61		
7	$221,063.61		
8	$266,795.31		
9	$323,129.88		
10	$377,897.01		
11	$405,269.01		
12	$424,123.09		
13	$426,286.01		
14	$426,286.01		
15	$426,286.01		

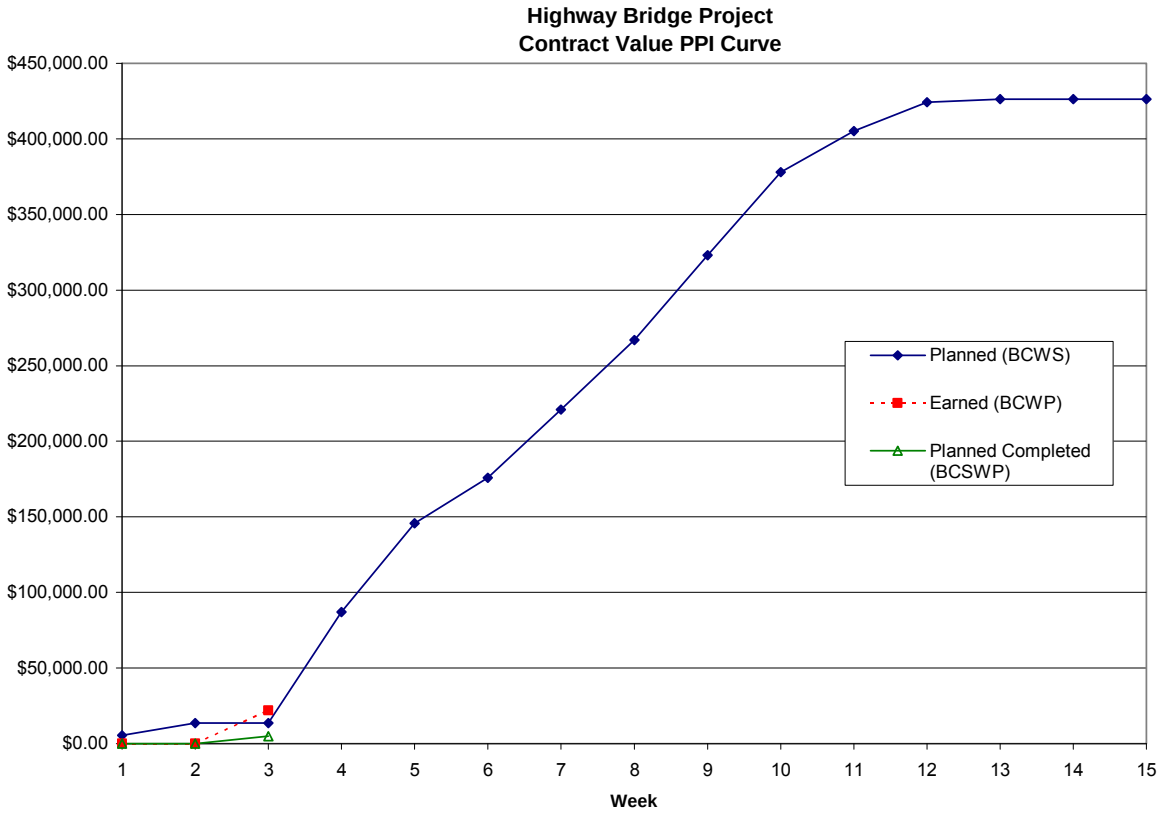


Figure 15: PPI Contract Value Commodity Curve through Week 3

It should be noted that during week 3, the BCWP is ahead of the BCWS, but the BCSWP is behind in comparison with the BCWS. Focus needs to be shifted from the activities and commodities that are ahead of schedule to those activities and commodities that are behind the as-planned schedule

before other activities that depend on their completion are affected and delay more activities further on in the schedule.

Using the Plan Performance Index for overall progress at week 3, it can be determined:

$$PPI = \frac{BCSWP}{BCWS} = \frac{\$4{,}830.97}{\$13{,}696.41} = 0.35$$

Since the PPI value of 0.35 is less than 1, the project is not performing according to plan.

The Plan Performance tracking technique can also be applied to commodities that are being tracked throughout the project. Table 6 is a summary of the values extracted from the commodity quantities through week 5. Figure 16 illustrates Table 6 graphically as a commodity curve.

Table 6: PPI Values for Rebar Commodity Curve through Week 5

Week	Rebar Planned (BCWS)	Rebar Earned (BCWP)	Rebar Planned Completed (BCSWP)
1	0	0	0
2	0	0	0
3	0	0	0
4	5,625	11,250	5,625
5	22,500	16,875	11,250
6	45,000		
7	45,000		
8	67,500		
9	67,500		
10	90,000		
11	90,000		
12	90,000		
13	90,000		
14	90,000		
15	90,000		

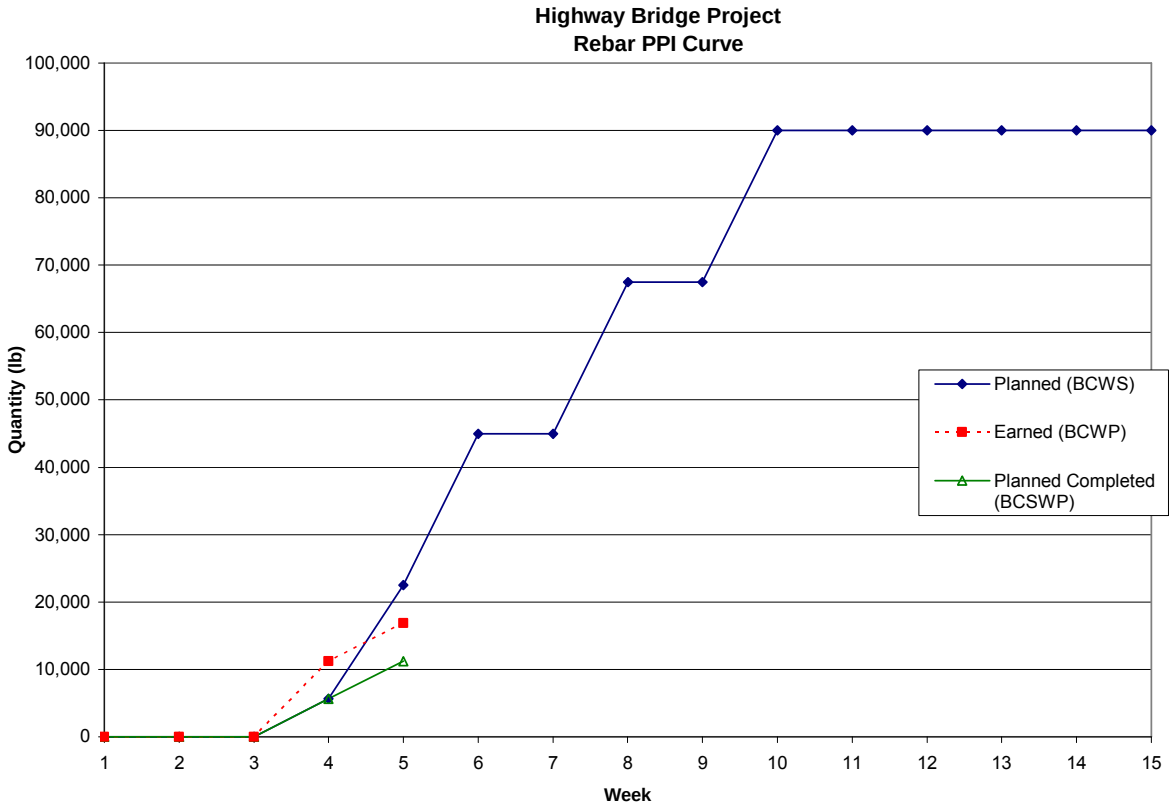


Figure 16: Highway Bridge PPI Commodity Curve for Rebar

It should be noted that in week 4, the planned quantity for rebar is equal to the planned completed quantity, which means this commodity is on track with its expected progression. It should also be noted that the earned quantity in week 4 is ahead of the planned quantity. These values indicate that the rebar is exceeding expectations overall. By week 5, both the earned and planned completed rebar

quantities fall behind the planned quantity, meaning focus must once again be shifted towards how well the plan is performing.

Using the SPI and PPI on week 5, it can be determined that:

$$SPI = \frac{BCWP}{BCWS} = \frac{16{,}875}{22{,}500} = 0.75$$

$$PPI = \frac{BCSWP}{BCWS} = \frac{11{,}250}{22{,}500} = 0.5$$

Refer to the as-planned and as-built schedule from Figure 14 once again. Activity 180 and 190 have rebar work associated with abutment #1 and footing #2, respectively. According to the as-planned schedule, the rebar for footing #2 should be completed, and rebar work for abutment #1 should not begin until week 6. In actuality, the rebar for abutment #1 started, and no work was done for rebar on footing no. 2.

The planning phase established the baseline for the overall project by breaking down the contract value into the earned value for each time period. Commodities can also be selected for tracking throughout the project, and their baselines were established based on the planned progress. The monitoring phase must be used to determine the progress as it stands from data collected in the field. The tracking and reporting phase of a construction project is important for evaluating the progress at the predetermined time periods during the project. The tracking and reporting phase should be used by project teams to determine how the project is progressing based on the established plan and the data collected from monitoring progress. Performance Indexes can quantify performance in terms of the planned and earned values with the Schedule Performance Index, and the planned and planned completed values with the Plan Performance Index. The tracking and reporting phase will establish how well the project is progressing, and if it is determined that the project is not progressing as planned, the project team can take corrective action by allocating resources to regain the intended progress for the duration of the project.

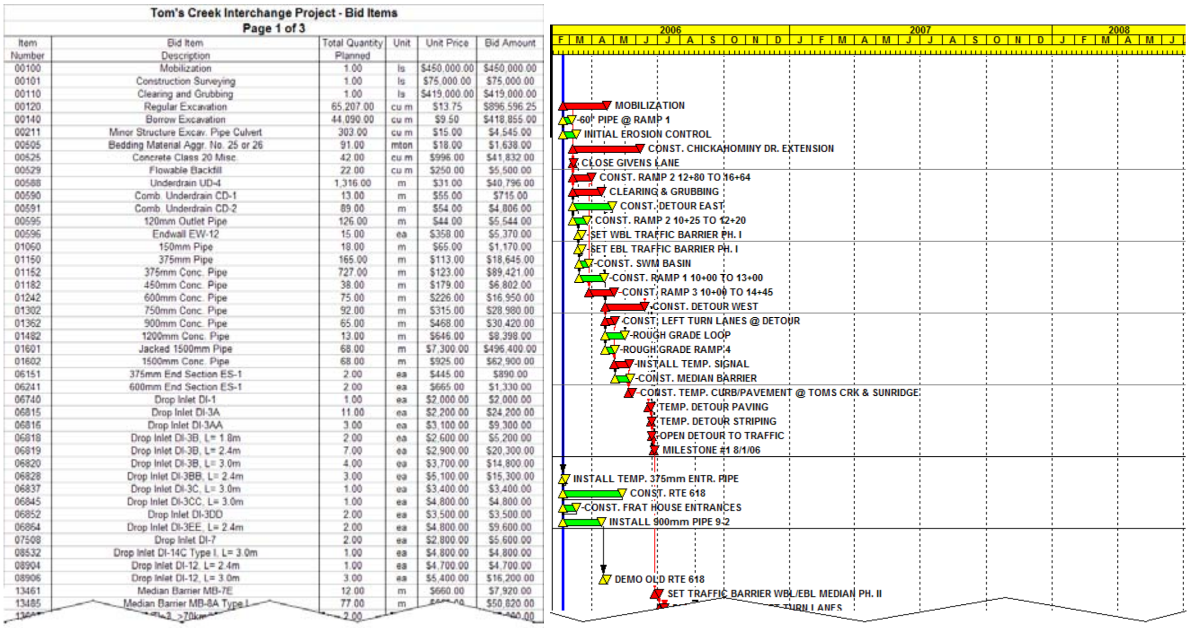
The Tom's Creek Interchange Project

The demonstration of tracking project commodities through the Highway Bridge project from the *Construction Project Management* (Clough et al. 2000) example is a much simpler example from a typical transportation project in the construction industry. To further illustrate the tracking of project commodities and controlling the schedule, this chapter will discuss the Plan Performance Index by applying it to an actual transportation construction project as a case study. The case study will focus on the Tom's Creek Interchange project in Blacksburg, VA. This project was designed by the Virginia Department of Transportation (VDOT) and administered as a unit price contract by the Town of Blacksburg, with construction completed by English Construction Company, Inc. The project consisted of the construction of four traffic ramps connecting to US-460 and Route 618, a loop for traffic exiting onto US-460 East

towards Christiansburg, a connection between Chickahominy Dr. and Givens Lane, and entrances to the Alpha Gamma Rho fraternity houses off of Route 618. The project is also comprised of a girder bridge overpass connecting Tom's Creek Road over US-460, eliminating the need for a traffic light at this intersection. Figure 17 is a picture highlighting the aspects of the project.

Figure 17: Plan View of the Tom's Creek Interchange

The Tom's Creek project will be used as a case study for demonstrating the tracking of commodities, similar in fashion to the project example from the previous chapters. Before commodities can be tracked, several pieces of information regarding the planning of the project must be obtained. As mentioned previously, the bid estimate and construction schedule, in conjunction with the design documents, will need to be obtained. Due to the magnitude of the bid items and the schedule (263 bid items and 105 activities), samples of the bid items and the schedule are displayed in Figure 18. Refer to the appendix for the complete documents.



Item Number	Bid Item Description	Total Quantity Planned	Unit	Unit Price	Bid Amount
00100	Mobilization	1.00	ls	$450,000.00	$450,000.00
00101	Construction Surveying	1.00	ls	$75,000.00	$75,000.00
00110	Clearing and Grubbing	1.00	ls	$419,000.00	$419,000.00
00120	Regular Excavation	65,207.00	cu m	$13.75	$896,596.25
00140	Borrow Excavation	44,090.00	cu m	$9.50	$418,855.00
00211	Minor Structure Excav. Pipe Culvert	303.00	cu m	$15.00	$4,545.00
00505	Bedding Material Aggr. No. 25 or 26	91.00	mton	$18.00	$1,638.00
00525	Concrete Class 20 Misc.	42.00	cu m	$996.00	$41,832.00
00529	Flowable Backfill	22.00	cu m	$250.00	$5,500.00
00588	Underdrain UD-4	1,316.00	m	$31.00	$40,796.00
00590	Comb. Underdrain CD-1	13.00	m	$55.00	$715.00
00591	Comb. Underdrain CD-2	89.00	m	$54.00	$4,806.00
00595	120mm Outlet Pipe	126.00	m	$44.00	$5,544.00
00596	Endwall EW-12	15.00	ea	$358.00	$5,370.00
01060	150mm Pipe	18.00	m	$65.00	$1,170.00
01150	375mm Pipe	165.00	m	$113.00	$18,645.00
01152	375mm Conc. Pipe	727.00	m	$123.00	$89,421.00
01182	450mm Conc. Pipe	38.00	m	$179.00	$6,802.00
01242	600mm Conc. Pipe	75.00	m	$226.00	$16,950.00
01302	750mm Conc. Pipe	92.00	m	$315.00	$28,980.00
01362	900mm Conc. Pipe	65.00	m	$468.00	$30,420.00
01482	1200mm Conc. Pipe	13.00	m	$646.00	$8,398.00
01601	Jacked 1500mm Pipe	68.00	m	$7,300.00	$496,400.00
01602	1500mm Conc. Pipe	68.00	m	$925.00	$62,900.00
06151	375mm End Section ES-1	2.00	ea	$445.00	$890.00
06241	600mm End Section ES-1	2.00	ea	$665.00	$1,330.00
06740	Drop Inlet DI-1	1.00	ea	$2,000.00	$2,000.00
06815	Drop Inlet DI-3A	11.00	ea	$2,200.00	$24,200.00
06816	Drop Inlet DI-3AA	3.00	ea	$3,100.00	$9,300.00
06818	Drop Inlet DI-3B, L= 1.8m	2.00	ea	$2,600.00	$5,200.00
06819	Drop Inlet DI-3B, L= 2.4m	7.00	ea	$2,900.00	$20,300.00
06820	Drop Inlet DI-3B, L= 3.0m	4.00	ea	$3,700.00	$14,800.00
06828	Drop Inlet DI-3BB, L= 2.4m	3.00	ea	$5,100.00	$15,300.00
06837	Drop Inlet DI-3C, L= 3.0m	1.00	ea	$3,400.00	$3,400.00
06845	Drop Inlet DI-3CC, L= 3.0m	1.00	ea	$4,800.00	$4,800.00
06852	Drop Inlet DI-3DD	2.00	ea	$3,500.00	$3,500.00
06864	Drop Inlet DI-3EE, L= 2.4m	2.00	ea	$4,800.00	$9,600.00
07508	Drop Inlet DI-7	2.00	ea	$2,800.00	$5,600.00
08532	Drop Inlet DI-14C Type I, L= 3.0m	1.00	ea	$4,800.00	$4,800.00
08904	Drop Inlet DI-12, L= 2.4m	1.00	ea	$4,700.00	$4,700.00
08906	Drop Inlet DI-12, L= 3.0m	3.00	ea	$5,400.00	$16,200.00
13461	Median Barrier MB-7E	12.00	m	$660.00	$7,920.00
13485	Median Barrier MB-8A Type I	77.00	m	[illegible]	$50,820.00

Figure 18: Samples From Tom's Creek Interchange Bid Estimate and Schedule (English Construction 2006)

The pro forma pay requests can be created from the bid items loaded into the schedule. These pro forma pay requests define a baseline for the quantities that are planned to be completed at the end of the predetermined time periods. For the Tom's Creek project, there were a total of 21 months planned for the entire project, but only the first 20 months were used to create pro forma pay requests because data from the actual commodity quantities from pay item documents were only generated those first 19 months. The work completed during those last few months was mostly landscaping and punch list activities, totaling to less than 5% of the total project estimate.

The time periods for the Tom's Creek project were determined to be monthly. Referring to the guideline established in Chapter 4, the time slices should cover 5 – 10% of the entire project, with the time slice but not exceeding a monthly time slice. Table 7 is an example of pro forma pay requests from the Tom's Creek Interchange project for this study, which references the first month of the project.

Table 7: Tom's Creek Pro Forma Pay Request for Month 1

Tom's Creek Interchange Project - Pro Forma Pay Request Feburary 2006 (Project Month 1) Page 1 of 1								
Bid Items				Month 1 Data				
Description	Total Quantity Planned	Unit	Unit Price	Quantity This Period	Quantity To Date	Planned Earnings This Period	Planned Earnings To Date	
Mobilization	1.00	ls	$450,000.00	0.50	0.50	$225,000.00	$225,000.00	
Construction Surveying	1.00	ls	$75,000.00	0.10	0.10	$7,500.00	$7,500.00	
Allaying Dust	100.00	hr	$55.00	5.00	5.00	$275.00	$275.00	
Field Office Type I	19.00	mo	$2,000.00	1.00	1.00	$2,000.00	$2,000.00	
				CONTRACT VALUE		**$234,775.00**	$234,775.00	

Selection of commodities for tracking throughout the project depends on the different activities and commodities taking place. Selecting contract value as a commodity to track is default for all projects because it determines the schedule performance of the entire project from a macro level. Since there are

several activities associated with the construction of several traffic ramps, the loop, and the main roadways, there will be placement of commodities such as aggregate, geotextile drainage fabric, and base asphalt concrete. Tracking each of these commodities would be counterproductive. More time and money would be expended rather than saved if every commodity was tracked.

The best commodity to track would be one related to the earlier stages of road construction, such as excavation, and one before the road is paved, such as the subbase or base materials. The reason to track something between excavation and paving is that the project status may go well during the excavating portion, but it is unknown how the rest of the project is doing if tracking does not occur after the excavating and before the end of the road construction, in this case the paving portion of the activity. Paving is not a good commodity to track because it occurs at the end of the road construction.

In the case of the Tom's Creek Project, tracking regular and borrow excavation, aggregate base 21B, and asphalt base course base mix 25 commodities would be optimal. All of these commodities occur throughout the project, are associated with several activities, and even fall on the critical path. Tracking commodities associated with the bridge would also be optimal, so the piling and reinforced steel associated with the bridge construction will also be tracked. Figure 19 is a summary of these commodity curves.

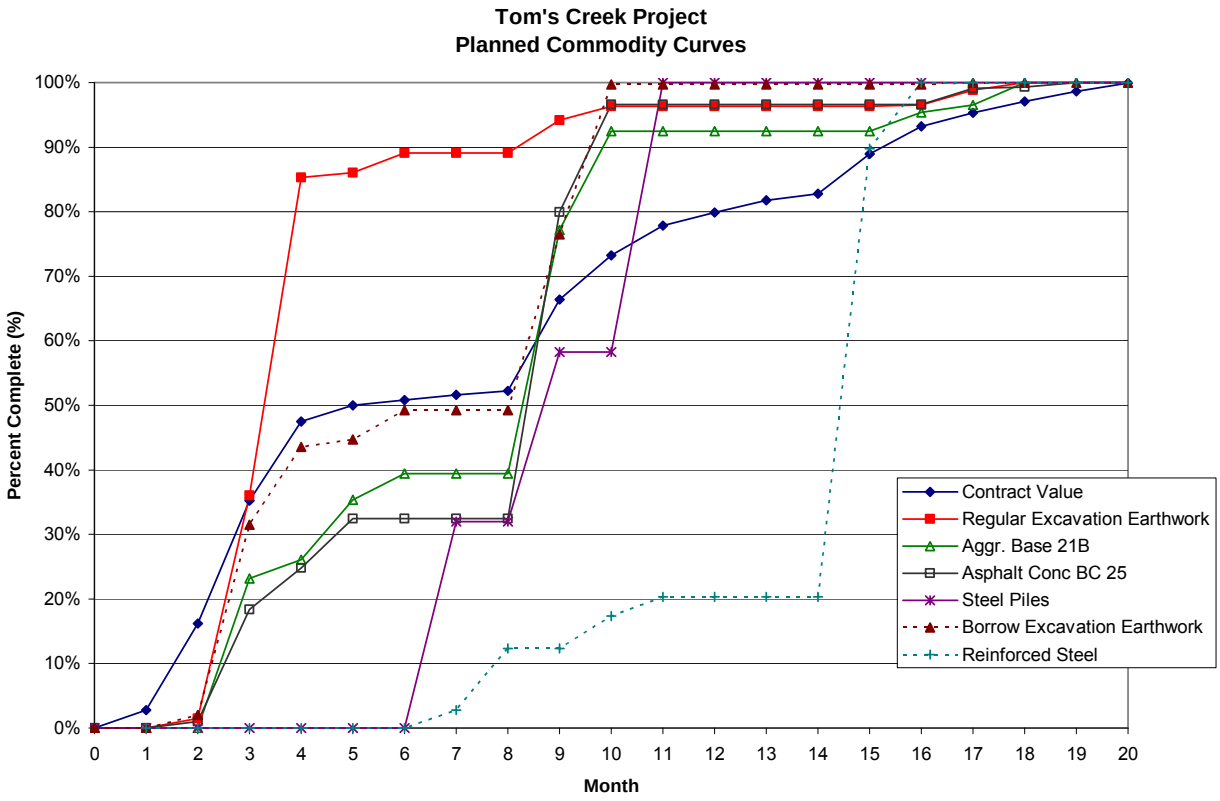


Figure 19: Planned Commodity Curves for Tom's Creek Interchange

Once construction commences, monitoring and reporting of the commodities must be maintained throughout the project. Project teams should review the progress throughout the construction of the project to ensure that everyone knows where the project stands and so there are no surprises and delays can be addressed appropriately. Once these quantities are reported at the end of each time slice, a commodity curve should be generated for each of the selected commodities to visualize the planned versus actual quantities.

During the first four months of the project, construction on Chickahominy Drive and Ramp 2 were to be completed. Figure 20 displays the commodity curve for contract value updated through month 4 of the project.

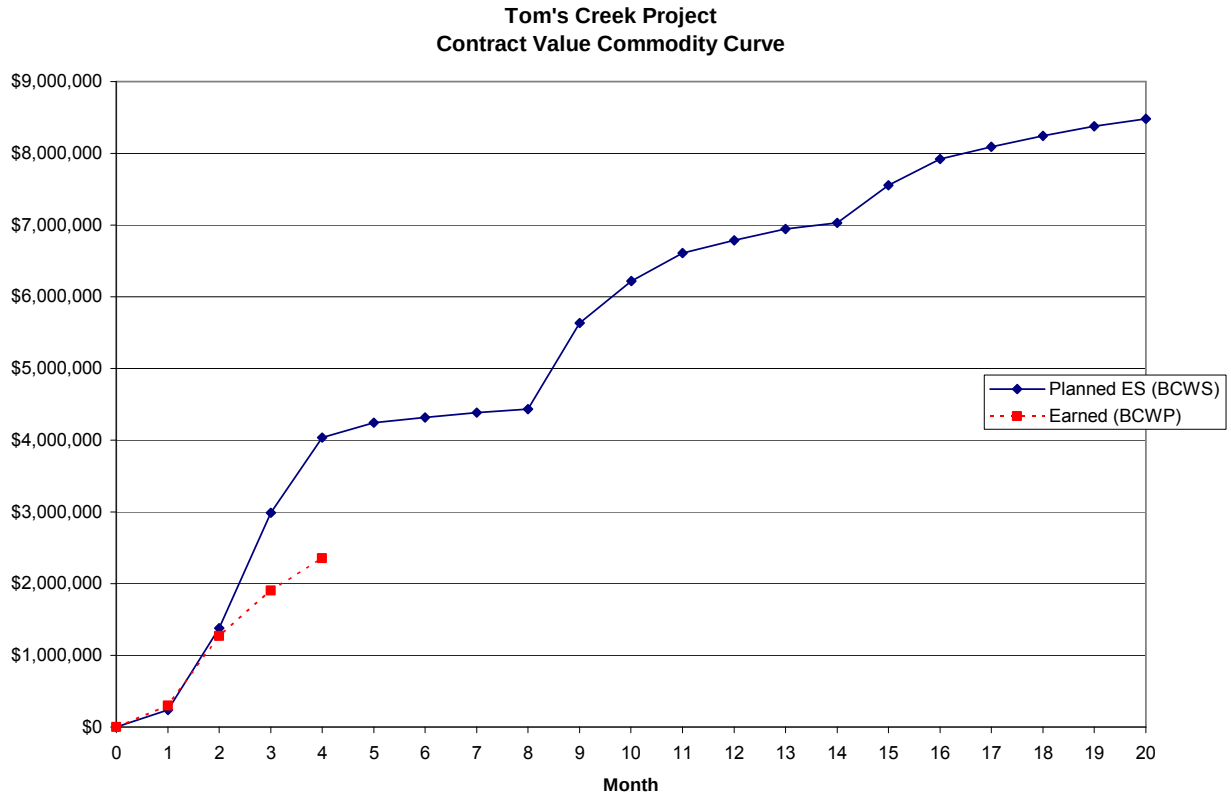


Figure 20: Contract Value of Tom's Creek Project through Month 4

In actuality, construction on Chickahominy Drive took longer than expected, and work on Ramp 2 was not finished at the end of the fourth month.

The metric for the Schedule Performance Index to determine how well the project is progressing:

$$\text{Schedule Performance Index} = \frac{\text{BCWP}}{\text{BCWS}} = \frac{\$2{,}408{,}306.87}{\$4{,}033{,}990.58} = 0.60$$

This indicates that the project is behind the expected contract value by 40%.

No matter how detailed a plan or how accurate an estimate is, completing a project perfectly as planned is almost impossible. Change is inevitable in a construction project. That is why the commodity curves must be updated as the project progresses. Even though a certain quantity of a commodity was estimated (especially for commodities such as aggregate base, concrete, and asphalt) for different activities, the actual quantity might be different from the planned quantity. Therefore, changing the quantity of such commodity and the planned contract value throughout the remainder of the project is of great importance. The remaining schedule plan should be updated to reflect this change.

For instance, the planned quantity for asphalt base course 25 at the end of month 19 during the project was determined to be 10,158 mton, when in fact 13,574.27 mton were actually placed. Once actual quantities are determined to be higher or lower in terms of the planned ones, the baseline commodity curve should be updated to reflect that change so that the tracking of commodities will be accurate throughout the project. Figure 21 illustrates the updated baseline as it could be reflected for the Tom's Creek project.

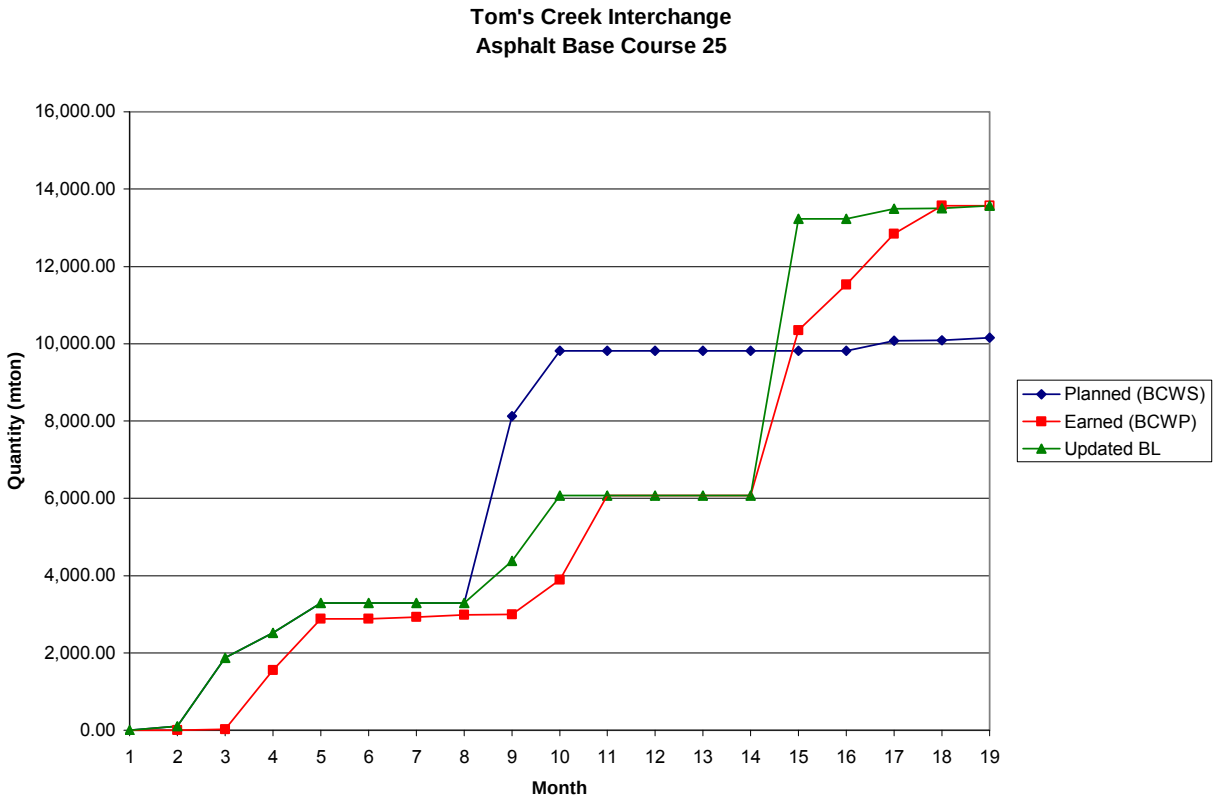


Figure 21: Original and Updated BC 25 for Tom's Creek Interchange Project

Figure 22 is an update of the schedule through month 5, the latest update available for the Tom's Creek Project. This will be utilized when discussing the Plan Performance Index equation.

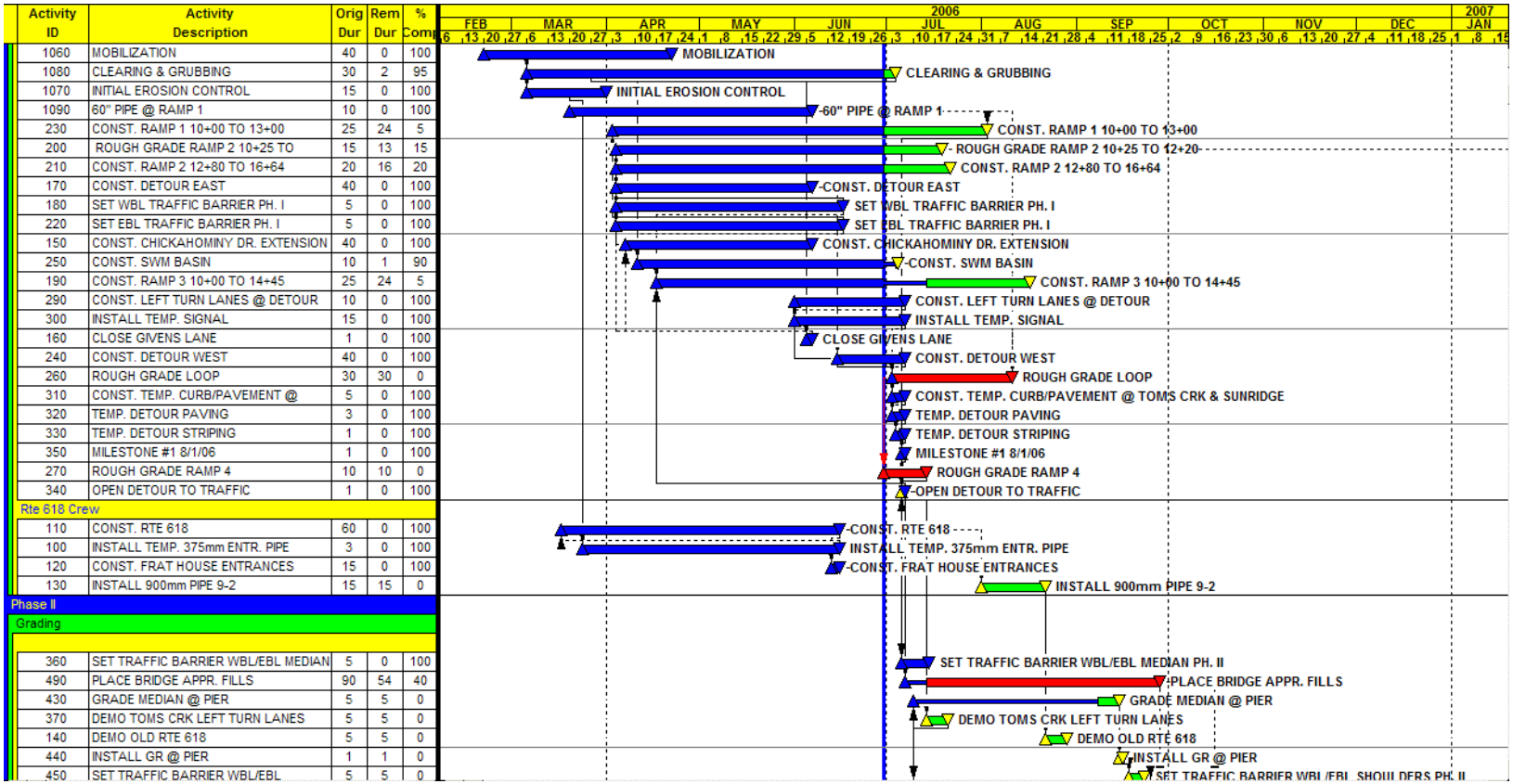


Figure 22: Updated Tom's Creek Schedule Through Month 5

Looking at Figure 22, it can be assessed that almost all of the activities to this point finished beyond the planned early finish date. According to the pay item summary tables for payments made to the contractor during the project, and this updated schedule, the pile driving activities started on time, but were accelerated due to incentives for completing the bridge ahead of schedule. The incentive was meant to have the overpass completed before students returned to school. Figure 23 is the commodity curve and updated baseline for the steel piling associated with the Tom's Creek project.

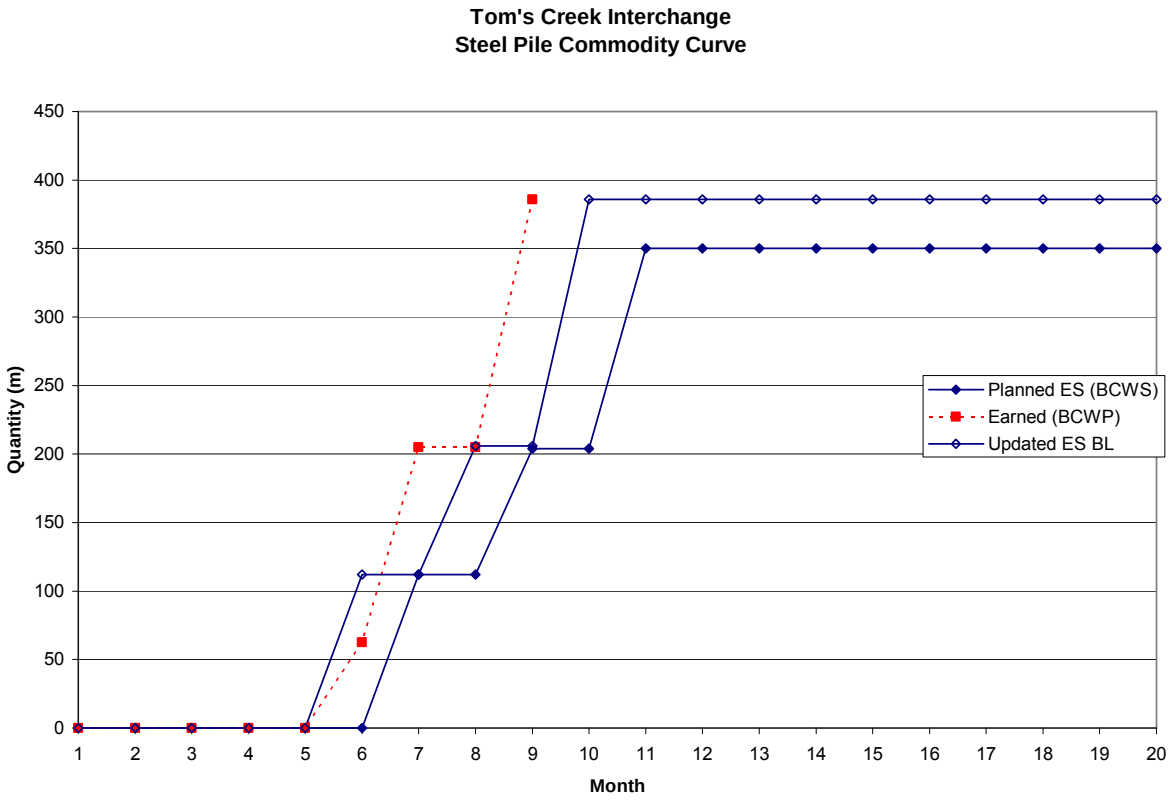


Figure 23: Commodity Curve for Tom's Creek Project's Steel Piles

Table 8 is a summary of the quantities for the steel piles, including BCSWP for the PPI, from the Tom's Creek project through month 9, which is one month before the piles were completed.

Table 8: Tom's Creek Summary of Pile Quantities for PPI

Steel Piles			
Month	**Updated BL (BCWS)**	**Earned (BCWP)**	**Planned Completed (BCSWP)**
1	0.00	0.00	0.00
2	0.00	0.00	0.00
3	0.00	0.00	0.00
4	0.00	0.00	0.00
5	0.00	0.00	0.00
6	112.00	62.60	62.60
7	205.80	205.80	205.80
8	205.80	205.80	205.80
9	205.80	385.80	205.80

From the pay item summary tables, it was determined that structure excavation, steel piles, reinforced steel, porous backfill, concrete slab slope protection, steel girders, epoxy coated reinforced steel, and Class 30 concrete were all commodities associated with the construction of the bridge that were ahead of their planned schedule during the construction phase. Table 9 reflects the overpass commodities stated above are ahead of schedule, and other commodities being behind schedule through month 9. Figure 24 visualizes these values through a commodity curve through the first nine weeks.

Table 9: Tom's Creek Contract Value Through Month 9 for PPI

Month	Contract Value		
	Updated BL (BCWS)	Earned (BCWP)	Planned Completed (BCSWP)
1	$234,775.00	$299,100.00	$299,100.00
2	$1,377,440.23	$1,266,481.27	$1,266,481.27
3	$2,989,988.95	$1,900,699.87	$1,900,699.87
4	$4,040,319.96	$2,408,306.87	$2,408,306.87
5	$4,250,801.94	$2,734,159.89	$2,734,159.89
6	$4,346,558.63	$3,165,698.53	$3,150,820.53
7	$4,398,338.26	$3,522,841.33	$3,498,586.33
8	$4,461,261.26	$3,705,039.03	$3,690,212.03
9	$5,627,132.26	$3,895,243.20	$3,858,808.20
10	$6,236,073.49		
11	$6,610,773.49		
12	$6,782,973.49		
13	$6,942,498.49		
14	$7,031,217.68		
15	$7,563,742.14		
16	$7,926,464.68		
17	$8,100,379.06		
18	$8,194,645.16		
19	$8,331,772.06		

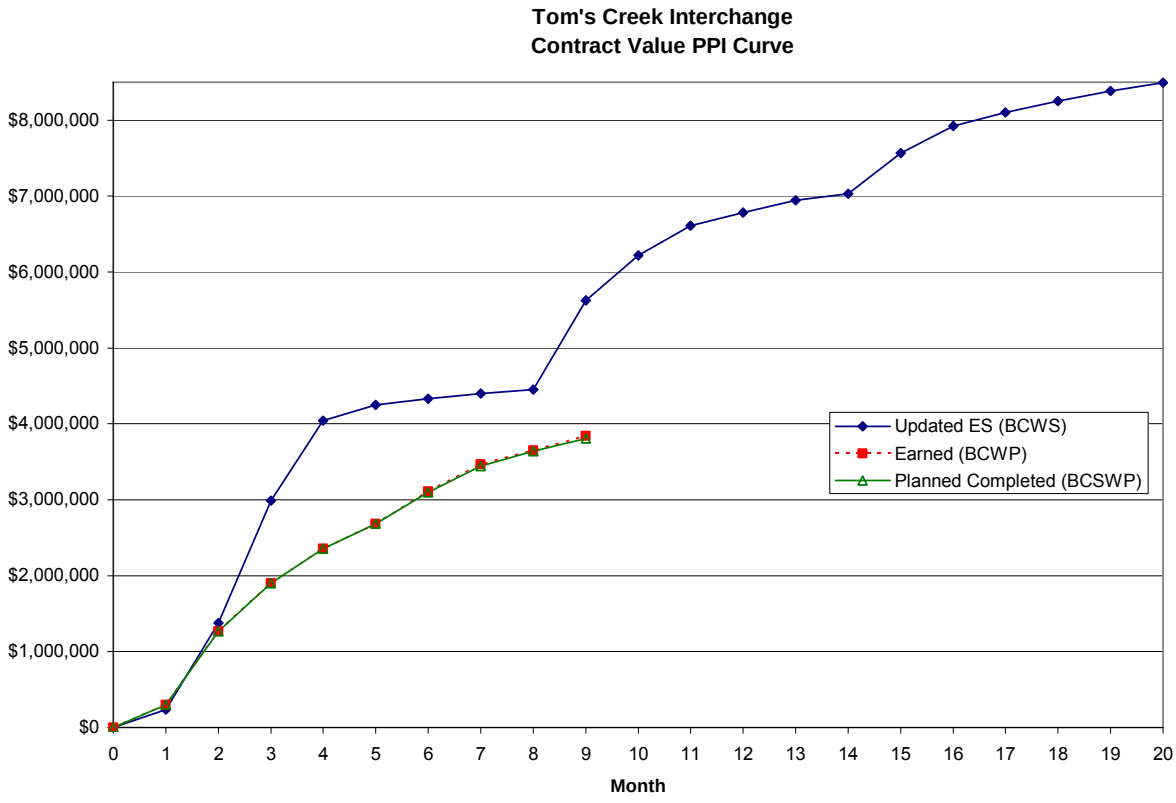


Figure 24: Contract Value of Tom's Creek for PPI through Month 9

Utilizing the equations for the Schedule Performance Index, it can be shown that during month 9:

$$SPI = \frac{BCWP}{BCWS} = \frac{\$3{,}895{,}243.20}{\$5{,}627{,}132.26} = 0.69$$

Since the SPI < 1.0, the Schedule Performance is lower than the planned expectations of the project. Calculating the Plan Performance Index for the contract value, it can be assessed that this is also not making the quota since SPI ≥ PPI:

$$PPI = \frac{BCSWP}{BCWS} = \frac{\$3{,}858{,}808.20}{\$5{,}627{,}132.26} = 0.69$$

Analysis of this contract value progress curve through the Plan Performance Index shows that even though the project is ahead with the pile driving and other bridge commodities, it is still not keeping pace with the planned contract value for the project. Even though the piling associated with the bridge is being completed ahead of schedule, most likely due to the monetary incentive, does not mean the overall plan is being implemented properly.

The Plan Performance Index can also be applied to individual commodities that are tracked throughout the project. For example, Figure 25 is a plot of the steel pile data through month 9 from Table 8.

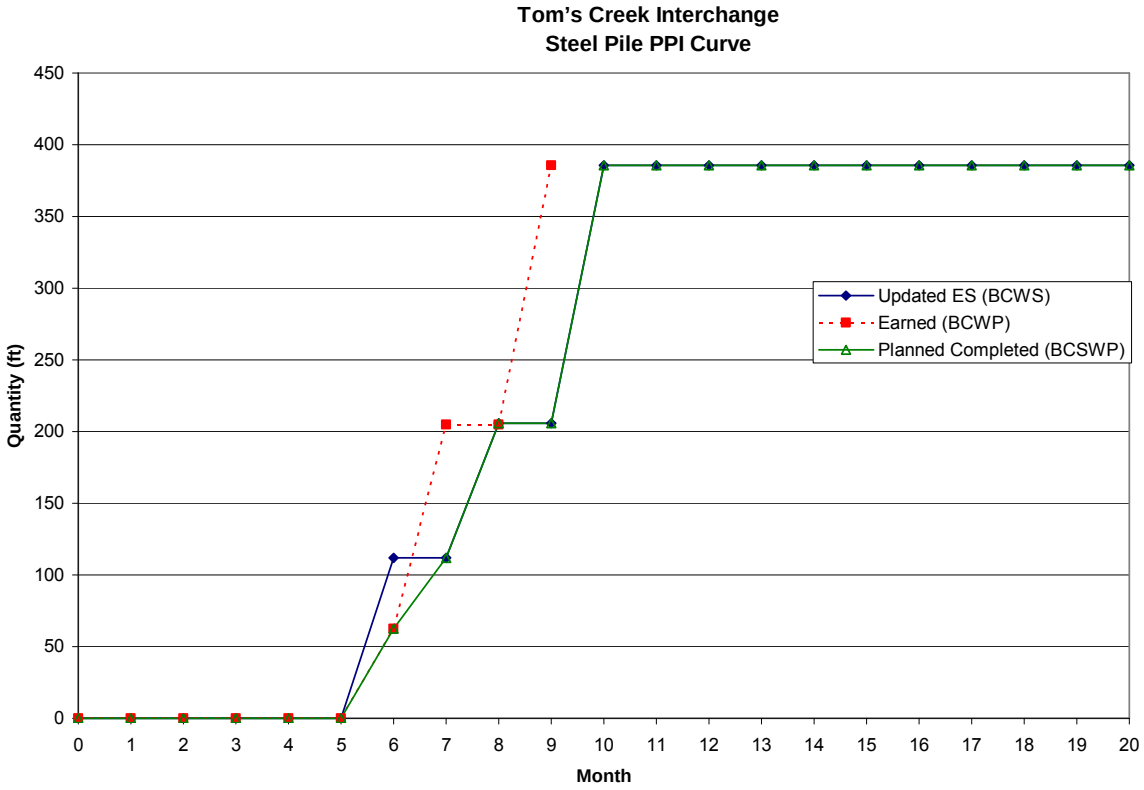


Figure 25: Tom's Creek Steel Piles for PPI through Month 9

Notice that in month 6 that BCWP = BCSWP because the quantity of steel piles is behind based on what was planned, and none of the planned quantities were completed ahead of schedule. In month 9, the Steel Piles finish ahead of the planned schedule, and *BCWS* = *BCSWP* because there was no steel pile work planned for that month.

Evaluating progress of steel piling during month 9, the Schedule Performance Index and Plan Performance Index values are:

$$SPI = \frac{BCWP}{BCWS} = \frac{385.8}{205.8} = 1.87$$

$$PPI = \frac{BCSWP}{BCWS} = \frac{205.8}{205.8} = 1.00$$

In other words, the planned steel pile is performing optimally with the commodity overall is ahead of schedule.

The overall project should be evaluated to determine if it ended up being completed successfully near completion. Figure 26 is a commodity curve for contract value through the end of month 20.

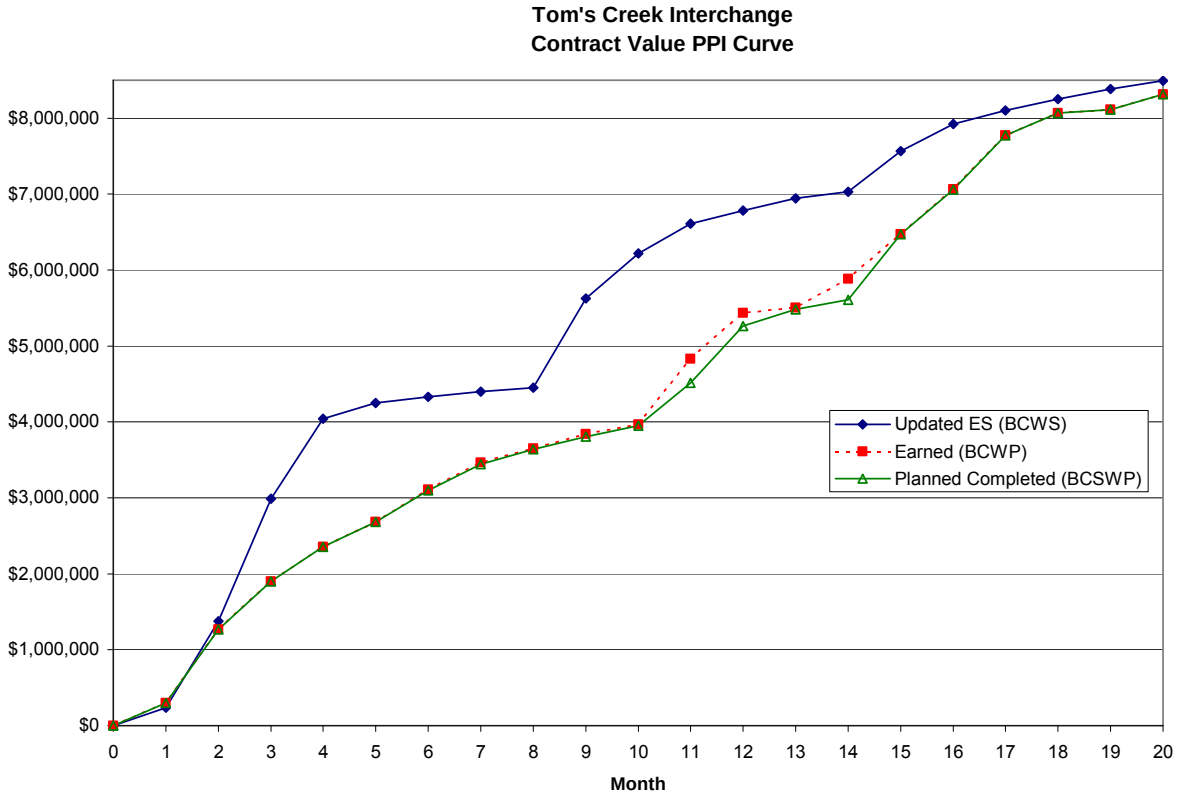


Figure 26: Tom's Creek Contract Value through Month 20

The SPI and PPI at this point are:

$$SPI = \frac{BCWP}{BCWS} = \frac{\$8{,}313{,}576}{\$8{,}492{,}150} = 0.98 \qquad PPI = \frac{BCSWP}{BCWS} = \frac{\$8{,}313{,}576}{\$8{,}492{,}150} = 0.98$$

The project has regained the intended progress overall and plan progress, just in time for the project to be completed in month 21.

Summary

Tracking project commodities adds another focus when controlling the progress of a construction project. When a project is tracked from a macro level, project teams lose sight of the details that are associated with overall project progress. The overall project progress should still be tracked, as well as commodities associated with the construction project, as this project & report has demonstrated through the Highway Bridge Project and the Tom's Creek Interchange Project.

This project & report acquired the essential information needed to demonstrate tracking project progress using commodity curves. It is apparent that the tracking of the overall construction project value from a macro level is limited to evaluating the health of the entire construction project, but not individual aspects. The tracking from a macro level cannot immediately decipher where the problem arises. It is impossible to stop a person from bleeding if one does not know where the wound is. The same goes for a construction project that is suffering from delays; it is known that the project is going poorly from tracking the overall project progress, but it is not possible to know exactly where progress is lagging.

Using the framework presented in Figure 1, shifting the focus towards tracking commodities for progress control would be structured as follows:

1. Commodity Planning & Scheduling
    a. Acquire design drawings, bid documents, and scheduling documents
    b. Select time slice periods
    c. Create pro forma pay requests
    d. Select commodities for tracking purposes
    e. Develop planned commodity curves
2. Commodity Monitoring
    a. Collect data in the field on progress that reflects reality
3. Commodity Tracking & Reporting
    a. Develop planned versus earned progress curves
    b. Quantify progress through SPI and PPI
    c. Evaluate progress

As an old saying goes, "fail to plan, plan to fail." Establishing a solid planning foundation through the development of a baseline commodity curve for selected commodities is an essential step towards tracking progress. The commodities chosen will be tracked throughout the construction phase of the project. The level of detail that is planned for before construction begins will be the level of control the project team will have on the overall project.

Monitoring the commodities changes the tracking methodology by focusing on specifics within the project, rather than only the status of the overall project. Since the monitoring of progress is commonly done in the field during construction projects, adding the monitoring of commodities would not require a great deal of change or added work for those monitoring progress.

As data is gathered in the field, the project can be evaluated at the end of each time slice. The creation of the planned and earned commodity curves can serve as valuable and practical resource for focusing on the progress of various aspects of a construction project, rather than looking at the health of the entire project. It takes tracking to the next step by breaking the project down and having an increased sense of awareness as to the progress of a variety of pieces of the project. By plotting the planned commodity curves and evaluating progress, project teams will undoubtedly be able to utilize this method and increase the success rate of the construction projects they monitor effectively. Project teams will be able to catch delays earlier in the construction phase, rather than waiting until the last minute and trying to expedite activities that have fallen behind.

The Schedule Performance Index quantifies the performance of the overall project as well as selected commodities in terms of the planned and earned values. The Plan Performance Index augments the Earned Value Method by introducing the Budgeted Cost of Scheduled Work Performed, or the planned completed values for the overall project and selected commodities. The Plan Performance Index focuses on progress that is ahead of the planned progress in some parts of the schedule, but behind in other parts. It helps determine if the project is behind or ahead overall, and if it is ahead overall, that the planned progress is also on schedule. The Plan Performance Index quantifies the performance of the overall project and selected commodities in terms of the planned progress and the planned completed progress.

Future research on the tracking of commodities would best entail the tracking of commodities for vertical construction projects. The Plan Performance Index could also be an interesting research area if the Plan Performance Index were used to evaluate the progress of every bid item associated with the Tom's Creek Interchange Project.

Tracking project commodities enhances the Earned Value Method by focusing on other aspects of the project besides overall progress. It takes tracking to another level of detail when commodities baselines are established during the planning phase, those commodities are monitored throughout the project, and the commodities are tracked and reported on throughout the construction of the project. The additional level of detail will increase the probability that the project will be completed within the constraints established during the planning phase of the project.

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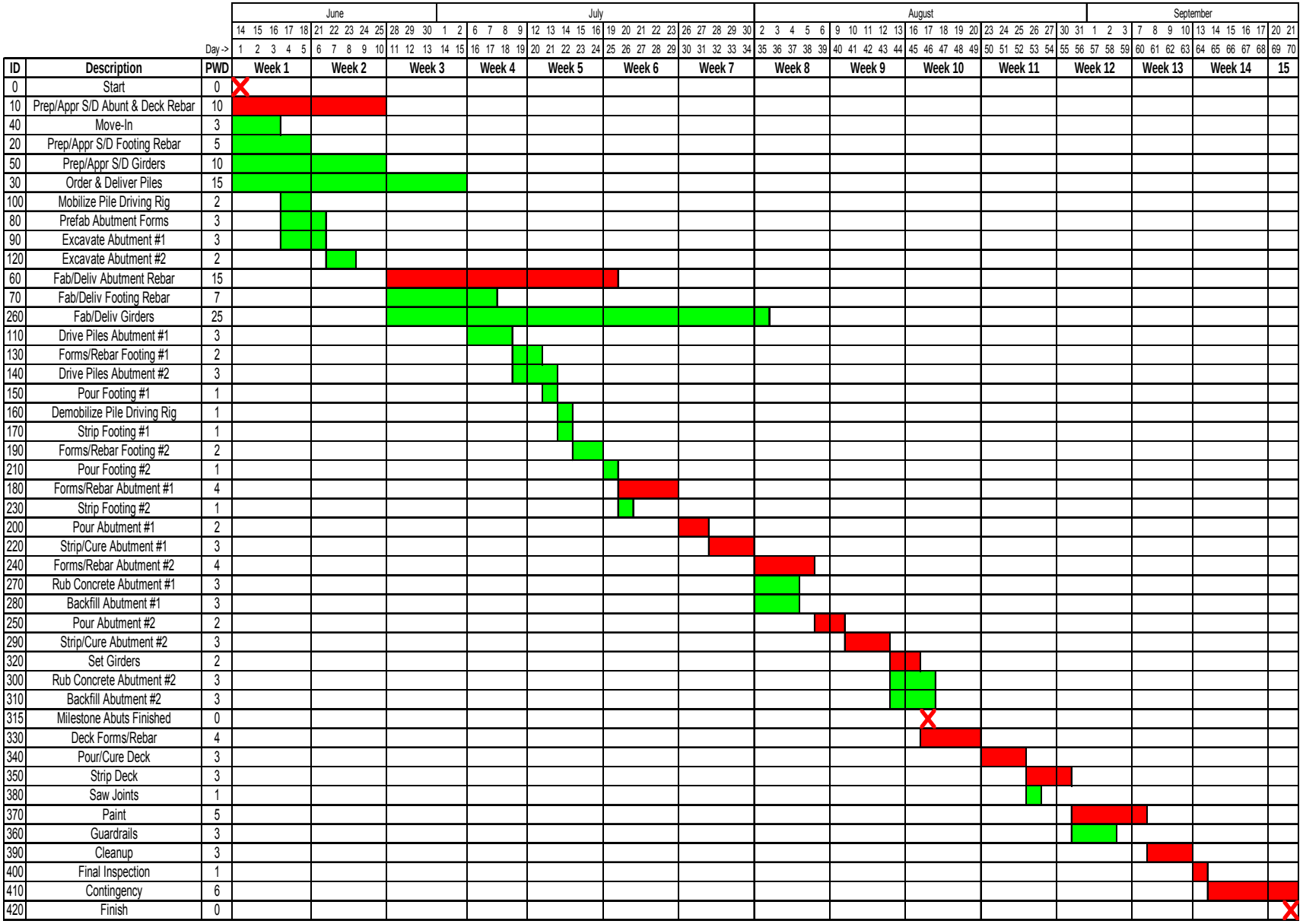
Highway Bridge Bid Items

Description	Commodity	Total Quantity Planned	Unit	Unit Price	Total Price
Excavation, unclassified	Soil	1,667	cy	$4.83	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	$80,640.00
Steel, structural	Girders	65,500	lb	$0.892	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	$6,944.00
Guardrail	Rail	120	lf	$85.02	$10,202.40
Paint	Paint	1	ls	$10,814.60	$10,814.60
				CONTRACT VALUE	**$426,286.01**


June
July
August
September
Day ->
ID
Description
PWD
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
Week 8
Week 9
Week 10
Week 11
Week 12
Week 13
Week 14
15
0 Start 0
10 Prep/Appr S/D Abunt & Deck Rebar 10
40 Move-In 3
20 Prep/Appr S/D Footing Rebar 5
50 Prep/Appr S/D Girders 10
30 Order & Deliver Piles 15
100 Mobilize Pile Driving Rig 2
80 Prefab Abutment Forms 3
90 Excavate Abutment #1 3
120 Excavate Abutment #2 2
60 Fab/Deliv Abutment Rebar 15
70 Fab/Deliv Footing Rebar 7
260 Fab/Deliv Girders 25
110 Drive Piles Abutment #1 3
130 Forms/Rebar Footing #1 2
140 Drive Piles Abutment #2 3
150 Pour Footing #1 1
160 Demobilize Pile Driving Rig 1
170 Strip Footing #1 1
190 Forms/Rebar Footing #2 2
210 Pour Footing #2 1
180 Forms/Rebar Abutment #1 4
230 Strip Footing #2 1
200 Pour Abutment #1 2
220 Strip/Cure Abutment #1 3
240 Forms/Rebar Abutment #2 4
270 Rub Concrete Abutment #1 3
280 Backfill Abutment #1 3
250 Pour Abutment #2 2
290 Strip/Cure Abutment #2 3
320 Set Girders 2
300 Rub Concrete Abutment #2 3
310 Backfill Abutment #2 3
315 Milestone Abuts Finished 0
330 Deck Forms/Rebar 4
340 Pour/Cure Deck 3
350 Strip Deck 3
380 Saw Joints 1
370 Paint 5
360 Guardrails 3
390 Cleanup 3
400 Final Inspection 1
410 Contingency 6
420 Finish 0

Pro Forma Pay Request
Week Ending June 18th (Project Week 1)
Highway Bridge Project

Bid Items					Week 1 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	834	834	$4,025.81	$4,025.81
Excavation, structural	Soil	120	cy	$47.04	30	30	$1,411.20	$1,411.20
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	0	0	$0.00	$0.00
Concrete, footings	Concrete	120	cy	$161.74	0	0	$0.00	$0.00
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	0	$0.00	$0.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$5,437.01**	$5,437.01

Pro Forma Pay Request
Week Ending June 25th (Project Week 2)
Highway Bridge Project

Bid Items					Week 2 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	834	1,667	$4,025.81	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	90	120	$4,233.60	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	0	0	$0.00	$0.00
Concrete, footings	Concrete	120	cy	$161.74	0	0	$0.00	$0.00
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	0	$0.00	$0.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$8,259.41**	$13,696.41

Pro Forma Pay Request
Week Ending July 2nd (Project Week 3)
Highway Bridge Project

Bid Items					Week 3 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$5,644.80	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	0	0	$0.00	$0.00
Concrete, footings	Concrete	120	cy	$161.74	0	0	$0.00	$0.00
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	0	$0.00	$0.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$5,644.80**	$13,696.41

Pro Forma Pay Request
Week Ending July 9th (Project Week 4)
Highway Bridge Project

Bid Items					Week 4 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	1,493	1,493	$68,170.38	$68,170.38
Concrete, footings	Concrete	120	cy	$161.74	0	0	$0.00	$0.00
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	5,625	5,625	$5,040.00	$5,040.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$73,210.38**	$86,906.79

Pro Forma Pay Request
Week Ending July 16th (Project Week 5)
Highway Bridge Project

Bid Items					Week 5 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	747	2,240	$34,108.02	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	60	60	$9,704.40	$9,704.40
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	16,875	22,500	$15,120.00	$20,160.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$58,932.42**	$145,839.21

Pro Forma Pay Request
Week Ending July 23rd (Project Week 6)
Highway Bridge Project

Bid Items					Week 6 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	60	120	$9,704.40	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	0	$0.00	$0.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	22,500	45,000	$20,160.00	$40,320.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$29,864.40**	$175,703.61

Pro Forma Pay Request
Week Ending July 30th (Project Week 7)
Highway Bridge Project

Bid Items					Week 7 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	0	$0.00	$0.00
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$9,704.40	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	140	140	$45,360.00	$45,360.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	45,000	$0.00	$40,320.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$55,064.40**	$221,063.61

Pro Forma Pay Request
Week Ending August 6th (Project Week 8)
Highway Bridge Project

Bid Items					Week 8 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	170	170	$2,891.70	$2,891.70
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$9,704.40	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	70	210	$22,680.00	$68,040.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	22,500	67,500	$20,160.00	$60,480.00
Steel, structural	Girders	65,500	lb	$0.89	0	0	$0.00	$0.00
Bearing plates	Plates	3,200	lb	$2.17	0	0	$0.00	$0.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$55,436.10**	$266,795.31

Pro Forma Pay Request
Week Ending August 13th (Project Week 9)
Highway Bridge Project

Bid Items					Week 9 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	57	227	$969.57	$3,861.27
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	70	280	$22,680.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	67,500	$0.00	$60,480.00
Steel, structural	Girders	65,500	lb	$0.89	32,750	32,750	$29,213.00	$29,213.00
Bearing plates	Plates	3,200	lb	$2.17	1,600	1,600	$3,472.00	$3,472.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$56,334.57**	$323,129.88

Pro Forma Pay Request
Week Ending August 20th (Project Week #10)
Highway Bridge Project

Bid Items					Week 10 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	113	340	$1,922.13	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	0	$0.00	$0.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	22,500	90,000	$20,160.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	32,750	65,500	$29,213.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	1,600	3,200	$3,472.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$54,767.13**	$377,897.01

Pro Forma Pay Request
Week Ending August 27th (Project Week 11)
Highway Bridge Project

Bid Items					Week 11 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	340	$0.00	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	56	56	$27,372.00	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	90,000	$0.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	0	65,500	$0.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	0	3,200	$0.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	0	0	$0.00	$0.00
Paint	Paint	1	ls	$10,814.60	0	0	$0.00	$0.00
						EARNED VALUE	**$27,372.00**	$405,269.01

Pro Forma Pay Request
Week Ending September 3rd (Project Week 12)
Highway Bridge Project

Bid Items					Week 12 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	340	$0.00	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	56	$0.00	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	90,000	$0.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	0	65,500	$0.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	0	3,200	$0.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	120	120	$10,202.40	$10,202.40
Paint	Paint	1	ls	$10,814.60	0.80	0.80	$8,651.68	$8,651.68
						EARNED VALUE	**$18,854.08**	$424,123.09

Pro Forma Pay Request
Week Ending September 10th (Project Week 13)
Highway Bridge Project

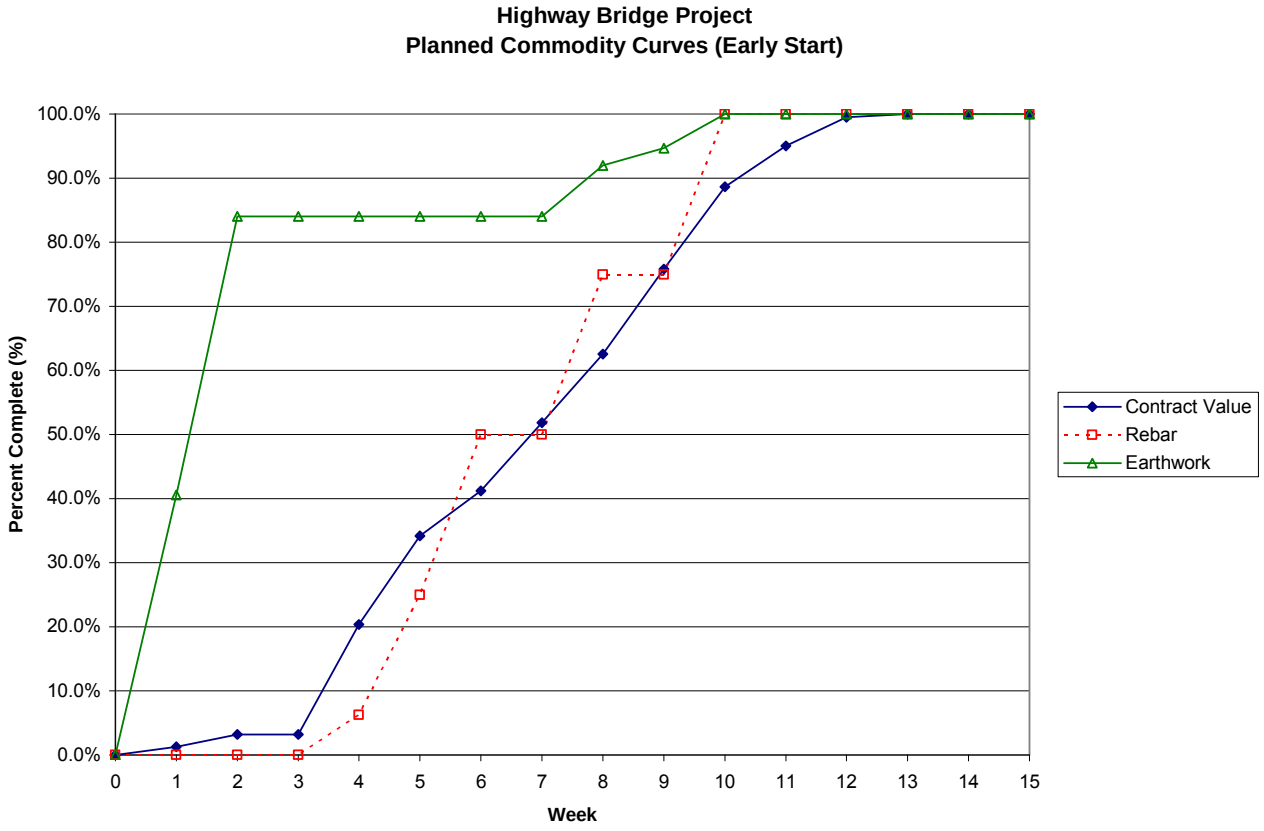
Bid Items					Week 13 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	340	$0.00	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	56	$0.00	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	90,000	$0.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	0	65,500	$0.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	0	3,200	$0.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	0	120	$0.00	$10,202.40
Paint	Paint	1	ls	$10,814.60	0.20	1.00	$2,162.92	$10,814.60
						EARNED VALUE	**$2,162.92**	$426,286.01

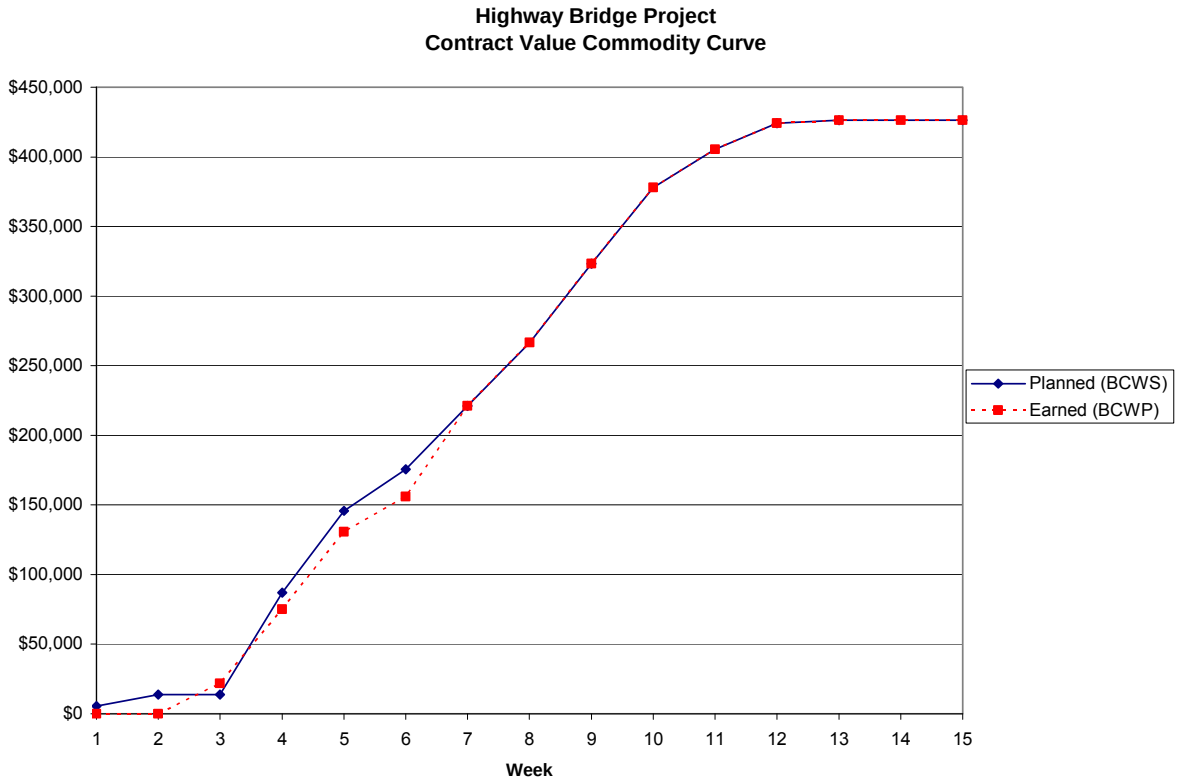
Pro Forma Pay Request
Week Ending September 17th (Project Week 14)
Highway Bridge Project

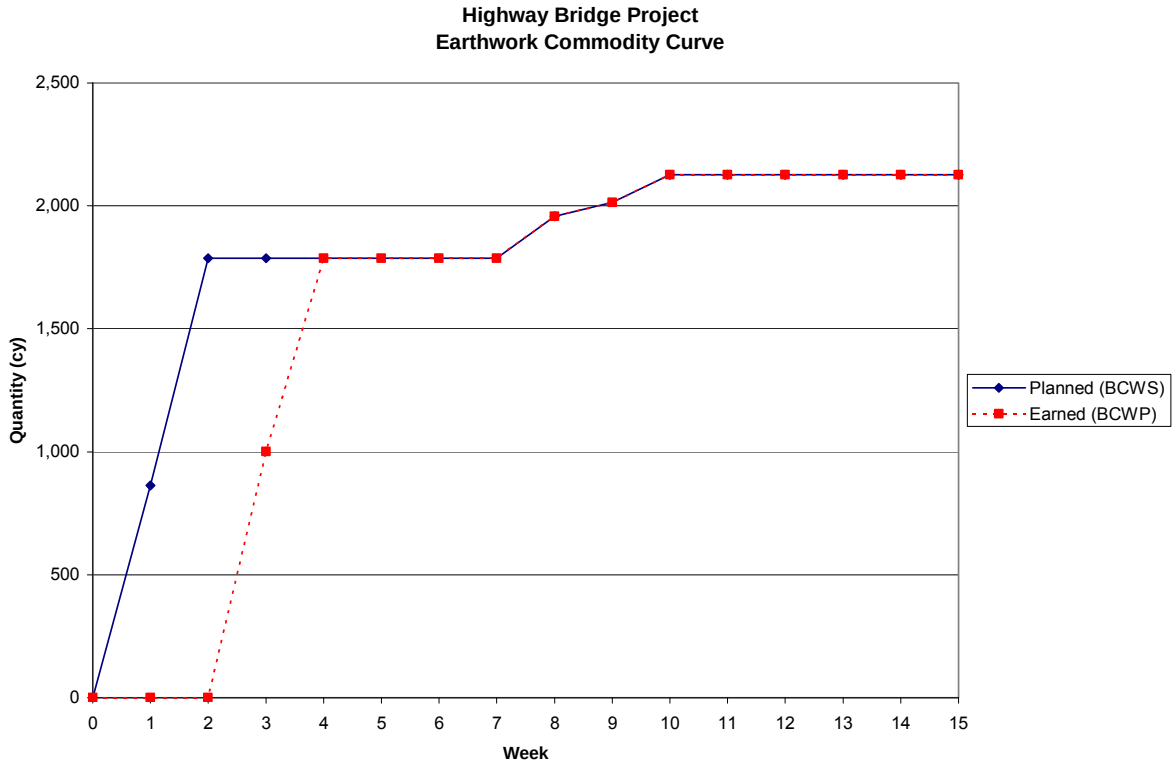
Bid Items					Week 14 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	340	$0.00	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	56	$0.00	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	90,000	$0.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	0	65,500	$0.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	0	3,200	$0.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	0	120	$0.00	$10,202.40
Paint	Paint	1	ls	$10,814.60	0	1	0	10,815
						EARNED VALUE	**$0.00**	$426,286.01

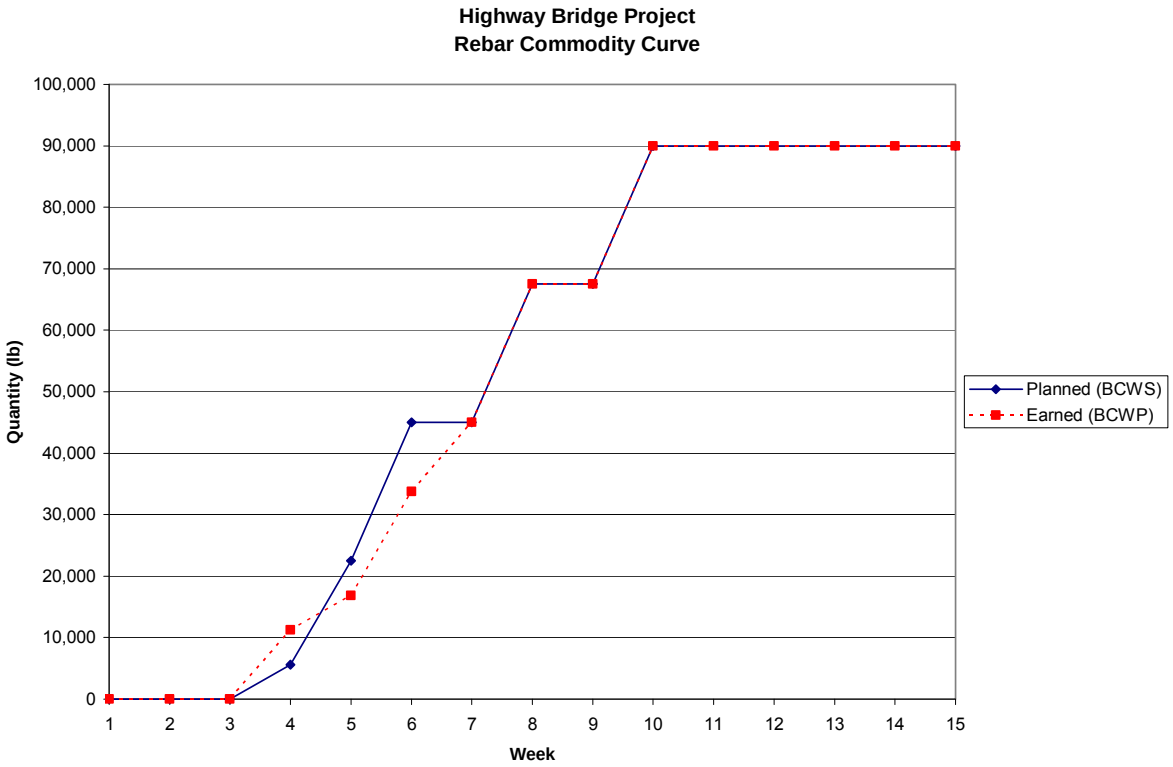
Pro Forma Pay Request
Week Ending September 24th (Project Week 15)
Highway Bridge Project

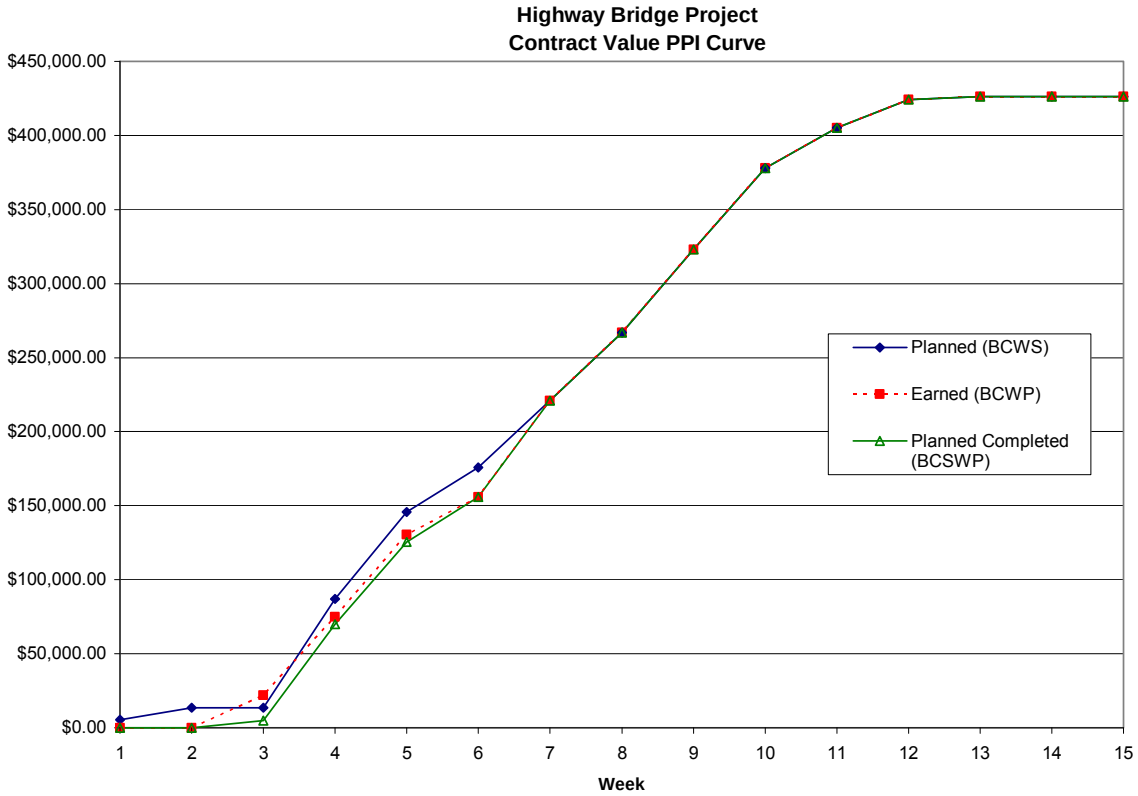
Bid Items					Week 24 Data			
Description	Commodity	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Excavation, unclassified	Soil	1,667	cy	$4.83	0	1,667	$0.00	$8,051.61
Excavation, structural	Soil	120	cy	$47.04	0	120	$0.00	$5,644.80
Backfill, compacted	Soil	340	cy	$17.01	0	340	$0.00	$5,783.40
Piling, steel	Steel	2,240	lf	$45.66	0	2,240	$0.00	$102,278.40
Concrete, footings	Concrete	120	cy	$161.74	0	120	$0.00	$19,408.80
Concrete, abutments	Concrete	280	cy	$324.00	0	280	$0.00	$90,720.00
Concrete, deck slab	Concrete	56	cy	$492.70	0	56	$0.00	$27,372.00
Steel, reinforcing	Rebar	90,000	lb	$0.90	0	90,000	$0.00	$80,640.00
Steel, structural	Girders	65,500	lb	$0.89	0	65,500	$0.00	$58,426.00
Bearing plates	Plates	3,200	lb	$2.17	0	3,200	$0.00	$6,944.00
Guardrail	Rail	120	lf	$85.02	0	120	$0.00	$10,202.40
Paint	Paint	1	ls	$10,814.60	0	1	0	$10,814.60
						EARNED VALUE	**$0.00**	$426,286.01


Highway Bridge Project
Planned Commodity Curves (Early Start)
Percent Complete (%)
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Week
Contract Value
Rebar
Earthwork


Highway Bridge Project
Contract Value Commodity Curve
$450,000
$400,000
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Week
Planned (BCWS)
Earned (BCWP)


Highway Bridge Project
Earthwork Commodity Curve
2,500
2,000
1,500
1,000
500
0
Quantity (cy)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Week
Planned (BCWS)
Earned (BCWP)


Highway Bridge Project
Rebar Commodity Curve
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Quantity (lb)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Week
Planned (BCWS)
Earned (BCWP)


Highway Bridge Project
Contract Value PPI Curve
$450,000.00
$400,000.00
$350,000.00
$300,000.00
$250,000.00
$200,000.00
$150,000.00
$100,000.00
$50,000.00
$0.00
1
2
3
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10
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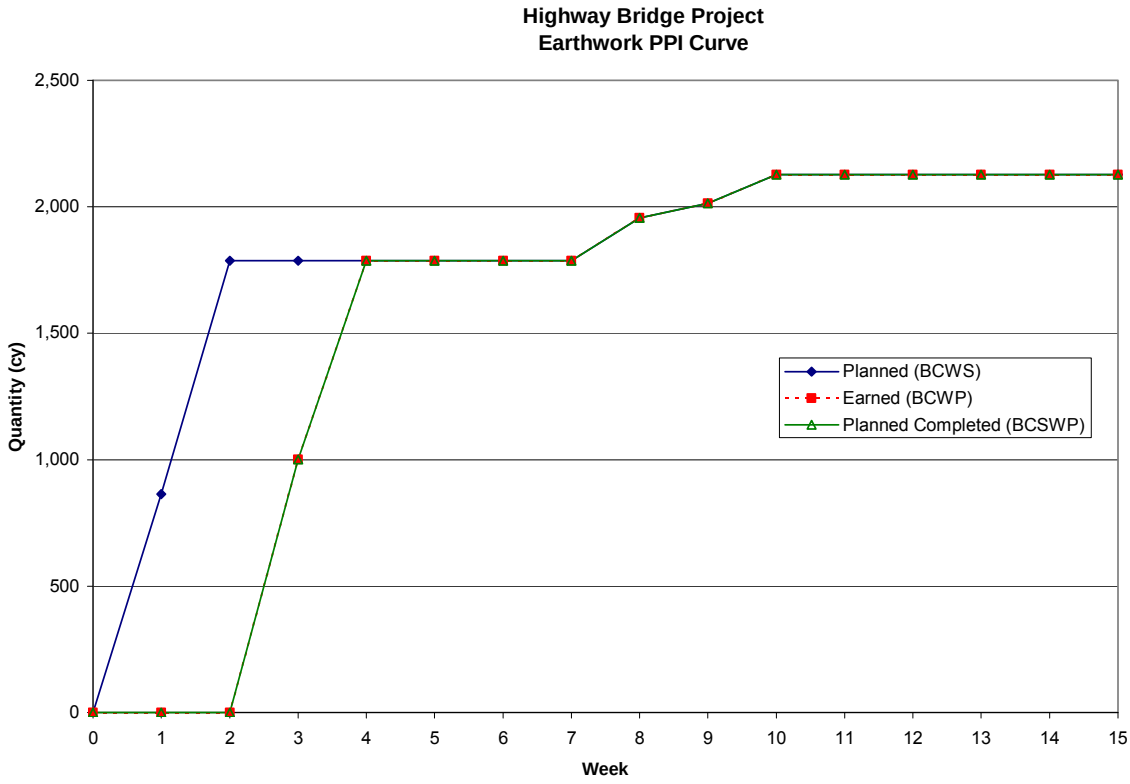
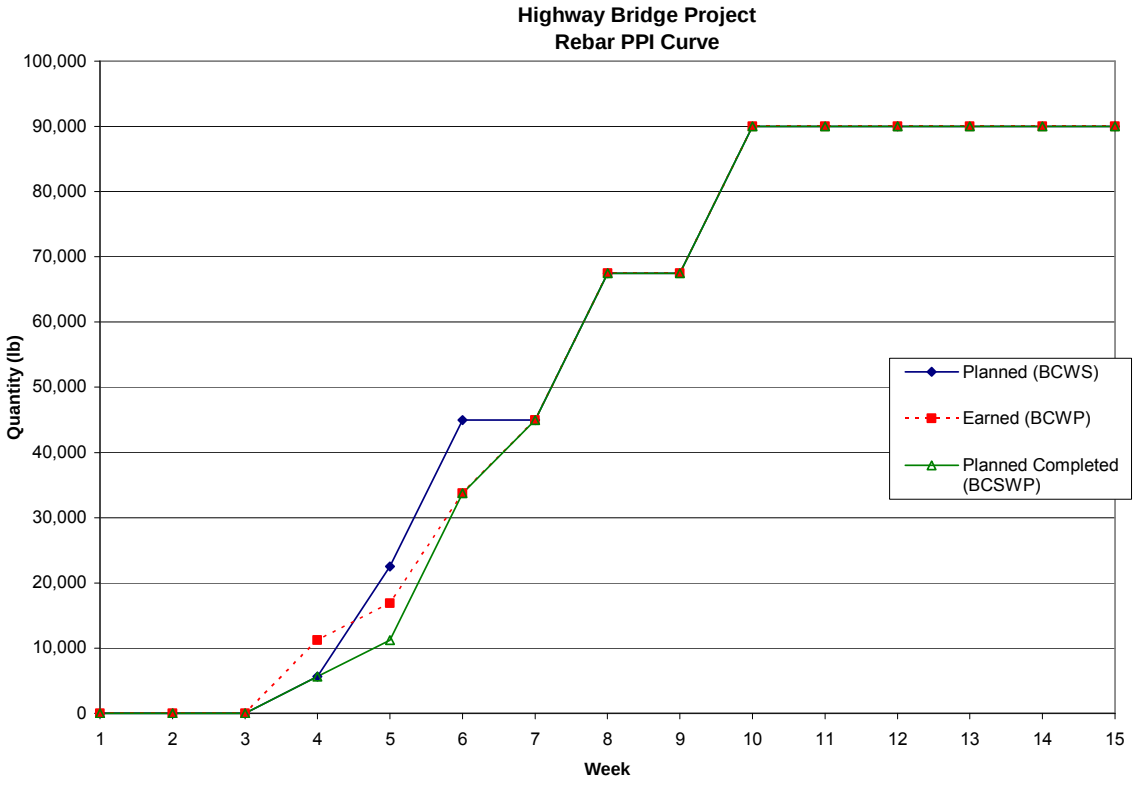
12
13
14
15
Week
Planned (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)


Highway Bridge Project
Earthwork PPI Curve
Quantity (cy)
2,500
2,000
1,500
1,000
500
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Week
Planned (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)


Highway Bridge Project
Rebar PPI Curve
Quantity (lb)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Week
Planned (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)

Appendix B: Tom's Creek Interchange Project Supporting Documents

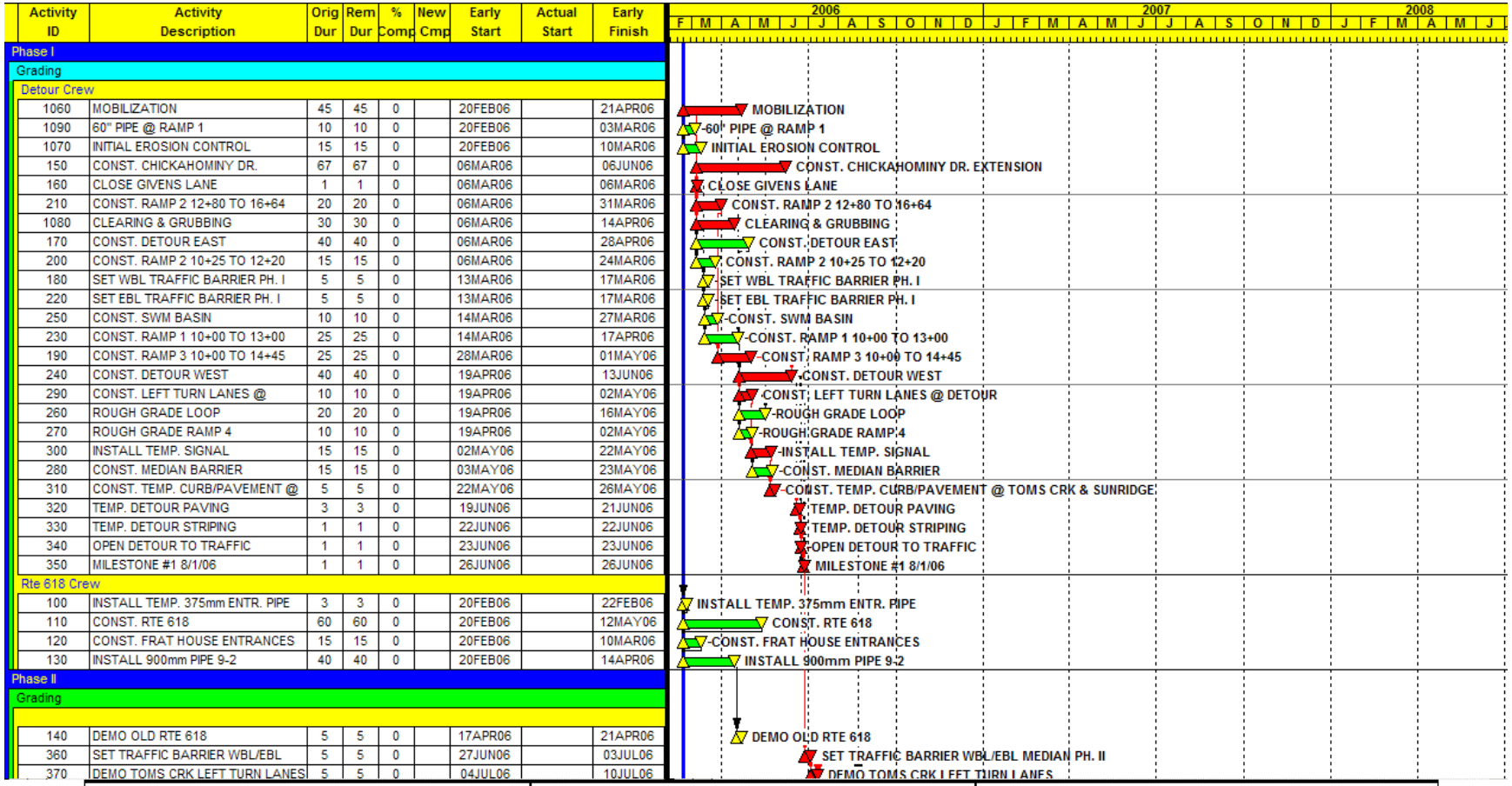
Tom's Creek Interchange Project - Bid Items Page 1 of 5					
Item Number	Bid Item Description	Total Quantity Planned	Unit	Unit Price	Bid Amount
00100	Mobilization	1.00	ls	$450,000.00	$450,000.00
00101	Construction Surveying	1.00	ls	$75,000.00	$75,000.00
00110	Clearing and Grubbing	1.00	ls	$419,000.00	$419,000.00
00120	Regular Excavation	65,207.00	cu m	$13.75	$896,596.25
00140	Borrow Excavation	44,090.00	cu m	$9.50	$418,855.00
00211	Minor Structure Excav. Pipe Culvert	303.00	cu m	$15.00	$4,545.00
00505	Bedding Material Aggr. No. 25 or 26	91.00	mton	$18.00	$1,638.00
00525	Concrete Class 20 Misc.	42.00	cu m	$996.00	$41,832.00
00529	Flowable Backfill	22.00	cu m	$250.00	$5,500.00
00588	Underdrain UD-4	1,316.00	m	$31.00	$40,796.00
00590	Comb. Underdrain CD-1	13.00	m	$55.00	$715.00
00591	Comb. Underdrain CD-2	89.00	m	$54.00	$4,806.00
00595	120mm Outlet Pipe	126.00	m	$44.00	$5,544.00
00596	Endwall EW-12	15.00	ea	$358.00	$5,370.00
01060	150mm Pipe	18.00	m	$65.00	$1,170.00
01150	375mm Pipe	165.00	m	$113.00	$18,645.00
01152	375mm Conc. Pipe	727.00	m	$123.00	$89,421.00
01182	450mm Conc. Pipe	38.00	m	$179.00	$6,802.00
01242	600mm Conc. Pipe	75.00	m	$226.00	$16,950.00
01302	750mm Conc. Pipe	92.00	m	$315.00	$28,980.00
01362	900mm Conc. Pipe	65.00	m	$468.00	$30,420.00
01482	1200mm Conc. Pipe	13.00	m	$646.00	$8,398.00
01601	Jacked 1500mm Pipe	68.00	m	$7,300.00	$496,400.00
01602	1500mm Conc. Pipe	68.00	m	$925.00	$62,900.00
06151	375mm End Section ES-1	2.00	ea	$445.00	$890.00
06241	600mm End Section ES-1	2.00	ea	$665.00	$1,330.00
06740	Drop Inlet DI-1	1.00	ea	$2,000.00	$2,000.00
06815	Drop Inlet DI-3A	11.00	ea	$2,200.00	$24,200.00
06816	Drop Inlet DI-3AA	3.00	ea	$3,100.00	$9,300.00
06818	Drop Inlet DI-3B, L= 1.8m	2.00	ea	$2,600.00	$5,200.00
06819	Drop Inlet DI-3B, L= 2.4m	7.00	ea	$2,900.00	$20,300.00
06820	Drop Inlet DI-3B, L= 3.0m	4.00	ea	$3,700.00	$14,800.00
06828	Drop Inlet DI-3BB, L= 2.4m	3.00	ea	$5,100.00	$15,300.00
06837	Drop Inlet DI-3C, L= 3.0m	1.00	ea	$3,400.00	$3,400.00
06845	Drop Inlet DI-3CC, L= 3.0m	1.00	ea	$4,800.00	$4,800.00
06852	Drop Inlet DI-3DD	2.00	ea	$3,500.00	$3,500.00
06864	Drop Inlet DI-3EE, L= 2.4m	2.00	ea	$4,800.00	$9,600.00
07508	Drop Inlet DI-7	2.00	ea	$2,800.00	$5,600.00
08532	Drop Inlet DI-14C Type I, L= 3.0m	1.00	ea	$4,800.00	$4,800.00
08904	Drop Inlet DI-12, L= 2.4m	1.00	ea	$4,700.00	$4,700.00
08906	Drop Inlet DI-12, L= 3.0m	3.00	ea	$5,400.00	$16,200.00
08916	Drop Inlet DI-12A, L= 2.4m	3.00	ea	$4,800.00	$14,400.00
08938	Drop Inlet DI-12C, L= 1.2m	1.00	ea	$2,500.00	$2,500.00
08940	Drop Inlet DI-12C, L= 1.8m	1.00	ea	$3,600.00	$3,600.00
08942	Drop Inlet DI-12C, L= 2.4m	0.00	ea	$4,200.00	$4,200.00
08944	Drop Inlet DI-12C, L= 3.0m	1.00	ea	$4,500.00	$4,500.00
08961	Drop Inlet DI-13 Type I	4.00	ea	$2,900.00	$11,600.00
08990	Drop Inlet DI-13, Type II	1.00	ea	$3,600.00	$3,600.00
09056	Manhole MH-1 or 2	42.00	m	$1,400.00	$58,800.00
09057	Frame and Cover MH-1	12.00	ea	$350.00	$4,200.00
09150	Erosion Control Stone Class I, EC-1	128.00	mton	$34.00	$4,352.00
09152	Erosion Control Stone Class II, EC-1	46.00	mton	$40.00	$1,840.00
09185	Paved Ditch PG-2A	238.00	sq m	$78.00	$18,564.00
09250	Slope Drain	20.00	ea	$250.00	$5,000.00

Tom's Creek Interchange Project - Bid Items Page 2 of 5					
Item Number	Bid Item Description	Total Quantity Planned	Unit	Unit Price	Bid Amount
10065	Aggragate Material No. 1	6,730.00	mton	$13.50	$90,855.00
10103	Aggragate Material No. 25 or 26	50.00	mton	$50.00	$2,500.00
10128	Aggragate Base Material Type I No. 21B	17,242.00	mton	$14.00	$241,388.00
10250	Aggragate Material #57	42.00	mton	$50.00	$2,100.00
10612	Asphalt Concrete Base Course Ty. BM-25.0	10,158.00	mton	$58.00	$589,164.00
10630	Flexible Pavement Planning	16,721.00	sq m	$1.80	$30,097.80
10636	Asphalt Concrete Type SM-9.5D	4,763.00	mton	$70.00	$333,410.00
11020	Concrete Class 30 Bridge Appr. Slab	115.00	cu m	$430.00	$49,450.00
11030	Reinforced Steel Bridge Appr. Slab	13,392.00	kg	$1.50	$20,088.00
11033	Prefab. Elastic Joint Sealer 75mm	44.00	m	$165.00	$7,260.00
12020	Standard Curb CG-2	233.00	m	$61.00	$14,213.00
12322	Asphalt Concrete Curb Type MC-3B	379.00	m	$33.00	$12,507.00
12505	Asphalt Concrete, Curb Backup Material	40.00	mton	$127.00	$5,080.00
12600	Standard Combination Curb and Gutter CG-6	836.00	m	$65.00	$54,340.00
12610	Radial Combination Curb and Gutter CG-6	388.00	m	$68.00	$26,384.00
12940	Entrance Gutter CG-9D	59.00	sq m	$105.00	$6,195.00
13108	CG-12 Detectable Warning Surface	30.00	sq m	$395.00	$11,850.00
13212	Right of Way Monument RM-2	60.00	ea	$25.00	$1,500.00
13220	Hydraulic Cement Concrete Sidewalk 100mm	1,085.00	sq m	$44.00	$47,740.00
13310	Guardrail Terminal GR-6 (NCHRP 350)	8.00	m	$275.00	$2,200.00
13312	Guardrail Terminal GR-7 (NCHRP 350)	13.00	ea	$2,085.00	$27,105.00
13315	Guardrail Terminal GR-11	12.00	ea	$603.00	$7,236.00
13320	Guardrail GR-2	2,180.00	m	$52.00	$113,360.00
13331	Radial Guardrail GR-2	111.00	m	$55.00	$6,105.00
13345	Alternate Breakaway Cable Terminal (GR-9)	5.00	ea	$2,200.00	$11,000.00
13383	Fixed Object Attach. GR-FOA-1 Type I	1.00	ea	$1,980.00	$1,980.00
13384	Fixed Object Attach. GR-FOA-1 Type II	1.00	ea	$343.00	$343.00
13392	Fixed Object Attach. GR-FOA-2 Type I	3.00	ea	$2,090.00	$6,270.00
13393	Fixed Object Attach. GR-FOA-2 Type II	1.00	ea	$343.00	$343.00
13421	Median Barrier MB-3	191.00	m	$82.00	$15,662.00
13461	Median Barrier MB-7E	12.00	m	$660.00	$7,920.00
13485	Median Barrier MB-8A Type I	77.00	m	$660.00	$50,820.00
13607	Impact Atten. (TL-3, >70km/hr Design Spec.)	2.00	ea	$18,000.00	$36,000.00
13623	Impact Attenuator Service Type II-12	8.00	ea	$6,000.00	$48,000.00
14162	Geotexile Drainage Fabric	97.00	sq m	$6.00	$582.00
14502	Reinforcing Steel	1,465.00	kg	$1.50	$2,197.50
21020	Median Strip MS-1	157.00	sq m	$99.00	$15,543.00
21215	Median Strip MS-2	126.00	m	$119.00	$14,994.00
22501	Fence FE-W1	1,447.00	m	$11.00	$15,917.00
22541	Line Brace Unit FE-W1, FE-W2	23.01	ea	$440.00	$10,120.00
22581	Corner Brace Unit FE-W1, FEW2	14.00	ea	$440.00	$6,160.00
24100	Allaying Dust	100.00	hr	$55.00	$5,500.00
24152	Type II Barricade 2.4m	14.00	ea	$500.00	$7,000.00
24272	Truck Mounted Attenuator	730.00	hr	$10.00	$7,300.00
24278	Group 2 Channelizing Devices	54,166.00	day	$0.50	$27,083.00
24279	Protable Changeable Message Sign	15,672.00	hr	$2.00	$31,344.00
24281	Electronic Arrow	730.00	hr	$5.00	$3,650.00
24282	Flagger Service	3,360.00	hr	$20.00	$67,200.00
24288	Warning Light Type B	6,945.00	day	$2.00	$13,890.00
24290	Traffic Barrier Service Concrete	2,150.00	m	$40.00	$86,000.00
24400	Obscuring Roadway	20.00	unit	$200.00	$4,000.00
24430	Demolition of Pavement (Flexible)	12,535.00	sq m	$3.00	$37,605.00
24702	Remove Existing Drop Inlet	6.00	ea	$500.00	$3,000.00
24702	Remove Existing Endwall	8.00	ea	$500.00	$4,000.00

Tom's Creek Interchange Project - Bid Items Page 3 of 5					
Item Number	Bid Item Description	Total Quantity Planned	Unit	Unit Price	Bid Amount
24703	Remove Existing Fence	925.00	m	$6.50	$6,012.50
24703	Remove Existing Guardrail	932.00	m	$6.00	$5,592.00
24703	Remove Existing Pipe	178.00	m	$35.00	$6,230.00
24712	Reset Existing Guardrail for Reuse	255.00	m	$33.00	$8,415.00
25505	Field Office Type I	19.00	mo	$2,000.00	$38,000.00
26117	Dry Riprap Cl. AI	2,642.00	mton	$30.00	$79,260.00
27012	Topsoil Cl. A 50mm	0.35	ha	$7,500.00	$2,625.00
27102	Regular Seed	429.00	kg	$23.00	$9,867.00
27103	Overseeding	268.00	kg	$7.00	$1,876.00
27104	Legume Seed	59.00	kg	$44.00	$2,596.00
27105	Legume Overseeding	37.00	kg	$44.00	$1,628.00
27215	Fertilizer (15-30-15)	2.50	mton	$594.00	$1,485.00
27250	Lime	19.00	mton	$121.00	$2,299.00
27321	Protective Covering EC-2	330.00	sq m	$2.50	$825.00
27410	Check Dam, Rock Type I	10.00	ea	$500.00	$5,000.00
27415	Check Dam (Rock) Type II	47.00	ea	$250.00	$11,750.00
27422	Dewatering Basin	4.00	ea	$500.00	$2,000.00
27430	Siltation Control Excavation	1,243.00	cu m	$9.00	$11,187.00
27440	Mowing	50.00	hr	$100.00	$5,000.00
27450	Drop Inlet Sil Trap, Type A	15.00	ea	$250.00	$3,750.00
27460	Drop Inlet Silt Trap, Type B	41.00	ea	$300.00	$12,300.00
27505	Temporary Silt Fence	1,563.00	m	$7.00	$10,941.00
27506	Temporary Filter Barrier	478.00	m	$6.50	$3,107.00
27543	Stormwater Management Liner	3,500.00	sq m	$12.00	$42,000.00
27545	Stormwater Management Basin Excavation	16,230.00	cu m	$13.50	$219,105.00
27580	Temporary Sediment Basin Excavation	396.00	cu m	$15.00	$5,940.00
28810	Mulching	51.50	unit	$42.00	$2,163.00
28811	Remulching	87.50	cu m	$42.00	$3,675.00
28820	Watering	85.00	unit	$110.00	$9,350.00
38900	Plant or Tree American Holly (Female), H= 180cm	81.50	ea	$388.00	$31,622.00
38900	Plant or Tree 'Brilliantissma' Choke Berry, #3 Cont.	277.00	ea	$34.00	$9,418.00
38900	Plant or Tree Ceylon Daffodil	616.00	ea	$3.50	$2,156.00
38900	Plant or Tree Eastern Red Cedar, H= 125cm	107.50	ea	$121.00	$13,007.50
38900	Plant or Tree Eastern Redbud, Multi-stem, H=125cm	30.00	ea	$121.00	$3,630.00
38900	Plant or Tree Happy Return - Daylilly, #1 Cont.	326.50	ea	$12.00	$3,918.00
38900	Plant or Tree Japanese Cedar, H= 180cm	27.50	ea	$224.00	$6,160.00
38900	Plant or Tree Norway Spruce, H= 180cm	11.00	ea	$224.00	$2,464.00
38900	Plant or Tree Red Sunset Maple Clump, H= 250cm	21.50	ea	$224.00	$4,816.00
38900	Plant or Tree Serviceberry Clump, H= 110cm	32.50	ea	$207.00	$6,727.50
38900	Plant or Tree Sherwood Glossy Abelia, #3 Cont.	30.50	ea	$45.00	$1,372.50
38900	Plant or Tree Summit Ash, 40mm Cal.	15.00	ea	$194.00	$2,910.00
38900	Plant or Tree Willow Oak Specimen, 20mm Cal.	4.50	ea	$183.00	$823.50
38950	Landscape Oversize Planting Pit	4.50	ea	$94.00	$423.00
38950	Landscape Removable Bollard	0.50	ea	$1,000.00	$500.00
39009	Vegetation Control Weeding	5.00	unit	$4,620.00	$46,200.00
40002	20mm Water Service Line	10.00	m	$165.00	$1,650.00
40061	150mm DI Water Main	14.00	m	$185.00	$2,590.00
40121	300mm DI Water Main	157.00	m	$410.00	$64,370.00
41006	150mm Gate Valve & Box	3.00	ea	$900.00	$2,700.00
41820	Fire Hydrant	2.00	ea	$3,200.00	$6,400.00
41971	20mm Water Meter & Box	3.00	ea	$750.00	$2,250.00
42082	200mm DI Sanitation Sewer Pipe	25.00	m	$720.00	$18,000.00
42755	Sanitary Sewar Manhole	9.00	m	$950.00	$8,550.00
42764	Manhole Frame & Cover F&C-1	3.00	ea	$400.00	$1,200.00

Tom's Creek Interchange Project - Bid Items Page 4 of 5					
Item Number	Bid Item Description	Total Quantity Planned	Unit	Unit Price	Bid Amount
50020	Road Edge Delineator ED-3, Type II, D-1	72.00	ea	$46.00	$3,312.00
50021	Road Edge Delineator ED-3, Type II, D-2	20.00	ea	$46.00	$920.00
50108	Sign Panel	149.00	sq m	$289.00	$43,061.00
50204	Sign Post Wood 100mm x 100mm	165.00	m	$29.00	$4,785.00
50206	Sign Post Wood 150mm x 150mm	124.00	m	$29.00	$3,596.00
50404	Sign Post Steel 100mm	25.00	m	$202.00	$5,050.00
50502	Concrete Foundation, SSP-V A 525mm Dia x 1350mm	6.00	ea	$693.00	$4,158.00
50575	Concrete Foundation Overhead Sign Structure	34.00	cu m	$1,155.00	$39,270.00
50900	Traffic Sign Post Wood 150mm x 200mm	48.00	m	$29.00	$1,392.00
50902	Traffic Sign Overhead Sign Structure Loc. No. 1	1.00	ea	$43,000.00	$43,000.00
50902	Traffic Sign Overhead Sign Structure Loc. No. 2	1.00	ea	$35,000.00	$35,000.00
50902	Traffic Sign Overhead Sign Structure Loc. No. 3	1.00	ea	$35,000.00	$35,000.00
50902	Traffic Sign Overhead Sign Structure Loc. No. 4	1.00	ea	$43,000.00	$43,000.00
51030	Controller	1.00	ea	$15,000.00	$15,000.00
51168	Electrical Service SE-3	1.00	ea	$704.00	$704.00
51210	Pedestal Pole PF-2 3m	1.00	ea	$642.00	$642.00
51234	Concrete Foundation Signal Pole	6.00	cu m	$1,525.00	$9,150.00
51240	Concrete Foundation PF-2	1.00	ea	$1,515.00	$1,515.00
51245	Concrete Foundation CD-1	1.00	ea	$2,500.00	$2,500.00
51402	Signal Pole MP-1 Comb. Lumin. One Arm 12m	1.00	ea	$6,100.00	$6,100.00
51425	Signal Pole MP-1 Com. Lum. Two Arms 11.5 16m	1.00	ea	$13,000.00	$13,000.00
51540	Loop Detector Amplifier	6.00	ea	$283.00	$1,698.00
51598	8/3 Conductor Cable	13.00	m	$22.00	$286.00
51599	12/1 Conductor Cable	423.00	m	$2.00	$846.00
51600	14/2 Conductor Cable	108.00	m	$3.30	$356.40
51601	14/3 Conductor Cable	112.00	m	$7.20	$806.40
51602	14/4 Conductor Cable	309.00	m	$5.50	$1,699.50
51700	14/2 Conductor Cable Shielded	160.00	m	$2.75	$440.00
51800	Pedestrian Pushbutton	2.00	ea	$195.00	$390.00
51830	Hanger Assembly SM-3, One Way	8.00	ea	$359.00	$2,872.00
51834	Hanger Assembly SM-2, One Way	1.00	ea	$367.00	$367.00
51838	Hanger Assembly SMB-3, One Way	1.00	ea	$300.00	$300.00
51910	Saw Cut	194.00	m	$19.00	$3,686.00
51950	Temporary Signalization	1.00	ls	$38,000.00	$38,000.00
52000	Traffic Signalization Remove Existing Signal Equipment	1.00	ls	$2,200.00	$2,200.00
52001	Traffic Signalization 50mm PVC Conduit	13.00	m	$44.00	$572.00
52001	Traffic Signalization Emergency Preemption Detector Cable	190.00	m	$4.40	$836.00
52002	Traffic Signalization Emergency Preemption One Way	3.00	ea	$3,218.00	$9,654.00
52002	Traffic Signalization Junction Box 3C	31.00	ea	$1,123.00	$34,813.00
52002	Traffic Signalization Junction Box 5C	1.00	ea	$3,009.00	$3,009.00
52002	Traffic Signalization Luminaire Arm 3.5m	2.00	ea	$547.00	$1,094.00
52002	Traffic Signalization Pedestrian Signal Head SP-7	4.00	ea	$992.00	$3,968.00
52002	Traffic Signalization Traffic Signal Head Sec. 305mm LED	25.00	ea	$324.00	$8,100.00
54022	Type A Pavement Line Marking 150mm	665.00	m	$3.60	$2,394.00
54028	Type A Pavement Line Marking 600mm	12.00	m	$18.00	$216.00
54032	Type B Class I Pavement Line Marking 100mm	7,232.00	m	$1.70	$12,294.40
54034	Type B Class I Pavement Line Marking 150mm	7,105.00	m	$2.50	$17,762.50
54037	Type B Class I Pavement Line Marking 200mm	1,500.00	m	$3.50	$5,250.00
54042	Type B Class I Pavement Line Marking 600mm	150.00	m	$36.00	$5,400.00
54075	Type B Class IV Pavement Line Marking 100mm	280.00	m	$11.00	$3,080.00
54100	Pavement Marking Performed 600mm x 900mm Yield Line	14.00	m	$65.00	$910.00
54101	Pavement Marking Elong. Arrow Type D	16.00	ea	$110.00	$1,760.00
54105	Eradication of Existing Pavement Marking	750.00	m	$4.00	$3,000.00
54240	Temporary Pavement Marker 1 Way	150.00	ea	$5.00	$750.00

Tom's Creek Interchange Project - Bid Items Page 5 of 5					
Item Number	Bid Item Description	Total Quantity Planned	Unit	Unit Price	Bid Amount
54254	Pavement Message Marker Bicycle Lane Symbol	7.00	ea	$165.00	$1,155.00
54300	Pavement Message Marker Elongated Arrow Single	12.00	ea	$110.00	$1,320.00
54466	Construction Pavement Marking (Type E) 150mm	1,000.00	m	$10.00	$10,000.00
54512	Construction Pavement Marking (Type D, Cl. II) 100mm	4,237.00	m	$6.50	$27,540.50
54516	Construction Pavement Marking (Type D, Cl. II) 200mm	445.00	m	$12.00	$5,340.00
54524	Construction Pavement Marking (Type D, Cl. II) 600mm	36.00	m	$38.00	$1,368.00
54552	Construction Pavement Marking (Type f, Cl. II) 100mm	1,253.00	m	$2.40	$3,007.20
55060	6 Conductor Cable	3,200.00	m	$3.00	$9,600.00
55080	8 Conductor Cable	600.00	m	$2.20	$1,320.00
55140	Concrete Foundation LF-1 Type A	17.00	ea	$1,634.00	$27,778.00
55166	Lighting Pole LP-1 9m - 3.5m	12.00	ea	$1,724.00	$20,688.00
55344	Electrical Service SE-7 Type A	4.00	ea	$1,198.00	$4,792.00
55353	Control Center CCW-1 Type D	1.00	ea	$2,730.00	$2,730.00
55502	Luminaire 250watt H.P.S.	14.00	ea	$570.00	$7,980.00
56014	Electrical Ser. Grd. Electrode (3m)	24.00	ea	$152.00	$3,648.00
56021	25mm PVC Conduit	28.00	m	$32.00	$896.00
56030	50mm Conduit	1,475.00	m	$8.80	$12,980.00
56200	Trench Excavation ECI-1	960.00	m	$6.60	$6,336.00
56205	Test Bore	6.00	ea	$781.00	$4,686.00
59000	Lighting Electrical Service SE-9, Type B	1.00	ea	$6,889.00	$6,889.00
59001	Lighting 100mm Pipe Sleeve	125.00	m	$57.00	$7,125.00
59001	Lighting Trench Excavation ECI-2	125.00	m	$17.00	$2,125.00
60404	Concrete Class 30	357.30	cu m	$600.00	$214,200.00
60490	Bridge Deck Grooving	894.00	sq m	$3.50	$3,129.00
61705	Epoxy Coated Reinforced Steel	38,600.00	kg	$2.00	$77,200.00
61750	Structural Steel High Strength Plate Girders	164,300.00	kg	$3.74	$614,000.00
62010	Concrete Parapet	56.00	m	$400.00	$22,400.00
62018	Railing, Aluminum	56.00	m	$600.00	$33,600.00
64011	Structure Excavation	240.00	cu m	$100.00	$24,000.00
64030	Porous Backfill	15.00	cu m	$100.00	$1,500.00
64036	Pipe Underdrain 150mm	65.00	m	$33.00	$2,145.00
64110	Steel Piles 250mm	350.00	m	$110.00	$38,500.00
65015	Concrete Class 25	248.00	cu m	$600.00	$148,800.00
65200	Reinforced Steel	13,250.00	kg	$1.80	$23,850.00
66740	Concrete Slab Slope Protection 100mm	390.00	sq m	$65.00	$25,350.00
66926	Bridge Substructure Elastic Inclusion 250mm Thickness	49.00	sq m	$150.00	$7,350.00
67086	Pedestrian Fence 1.8m	56.00	m	$390.00	$21,840.00
67090	Pedestrian Fence Modified	56.00	m	$330.00	$18,480.00
69155	Pile Point for 250mm Steel Pile	84.00	ea	$100.00	$8,400.00
70000	Demolition of Building Parcel 001, D-1	1.00	ls	$1.00	$1.00
70000	Demolition of Building Parcel 001, D-2	1.00	ls	$1.00	$1.00
70200	Clearing of Parcel No. 001	1.00	ls	$1.00	$1.00
70200	Clearing of Parcel No. 002	1.00	ls	$1.00	$1.00
70200	Clearing of Parcel No. 003	1.00	ls	$1.00	$1.00
70200	Clearing of Parcel No. 005	1.00	ls	$1.00	$1.00
70200	Clearing of Parcel No. 007	1.00	ls	$1.00	$1.00
70200	Clearing of Parcel No. 011	1.00	ls	$1.00	$1.00
				CONTRACT VALUE	**$8,347,767.95**



Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	New Cmp	Early Start	Actual Start	Early Finish
Phase I								
Grading								
Detour Crew								
1060	MOBILIZATION	45	45	0		20FEB06		21APR06
1090	60" PIPE @ RAMP 1	10	10	0		20FEB06		03MAR06
1070	INITIAL EROSION CONTROL	15	15	0		20FEB06		10MAR06
150	CONST. CHICKAHOMINY DR.	67	67	0		06MAR06		06JUN06
160	CLOSE GIVENS LANE	1	1	0		06MAR06		06MAR06
210	CONST. RAMP 2 12+80 TO 16+64	20	20	0		06MAR06		31MAR06
1080	CLEARING & GRUBBING	30	30	0		06MAR06		14APR06
170	CONST. DETOUR EAST	40	40	0		06MAR06		28APR06
200	CONST. RAMP 2 10+25 TO 12+20	15	15	0		06MAR06		24MAR06
180	SET WBL TRAFFIC BARRIER PH. I	5	5	0		13MAR06		17MAR06
220	SET EBL TRAFFIC BARRIER PH. I	5	5	0		13MAR06		17MAR06
250	CONST. SWM BASIN	10	10	0		14MAR06		27MAR06
230	CONST. RAMP 1 10+00 TO 13+00	25	25	0		14MAR06		17APR06
190	CONST. RAMP 3 10+00 TO 14+45	25	25	0		28MAR06		01MAY06
240	CONST. DETOUR WEST	40	40	0		19APR06		13JUN06
290	CONST. LEFT TURN LANES @	10	10	0		19APR06		02MAY06
260	ROUGH GRADE LOOP	20	20	0		19APR06		16MAY06
270	ROUGH GRADE RAMP 4	10	10	0		19APR06		02MAY06
300	INSTALL TEMP. SIGNAL	15	15	0		02MAY06		22MAY06
280	CONST. MEDIAN BARRIER	15	15	0		03MAY06		23MAY06
310	CONST. TEMP. CURB/PAVEMENT @	5	5	0		22MAY06		26MAY06
320	TEMP. DETOUR PAVING	3	3	0		19JUN06		21JUN06
330	TEMP. DETOUR STRIPING	1	1	0		22JUN06		22JUN06
340	OPEN DETOUR TO TRAFFIC	1	1	0		23JUN06		23JUN06
350	MILESTONE #1 8/1/06	1	1	0		26JUN06		26JUN06
Rte 618 Crew								
100	INSTALL TEMP. 375mm ENTR. PIPE	3	3	0		20FEB06		22FEB06
110	CONST. RTE 618	60	60	0		20FEB06		12MAY06
120	CONST. FRAT HOUSE ENTRANCES	15	15	0		20FEB06		10MAR06
130	INSTALL 900mm PIPE 9-2	40	40	0		20FEB06		14APR06
Phase II								
Grading								
140	DEMO OLD RTE 618	5	5	0		17APR06		21APR06
360	SET TRAFFIC BARRIER WBL/EBL	5	5	0		27JUN06		03JUL06
370	DEMO TOMS CRK LEFT TURN LANES	5	5	0		04JUL06		10JUL06

Start Date	13FEB06
Finish Date	25OCT07
Data Date	20FEB06
Run Date	13NOV07 12:26

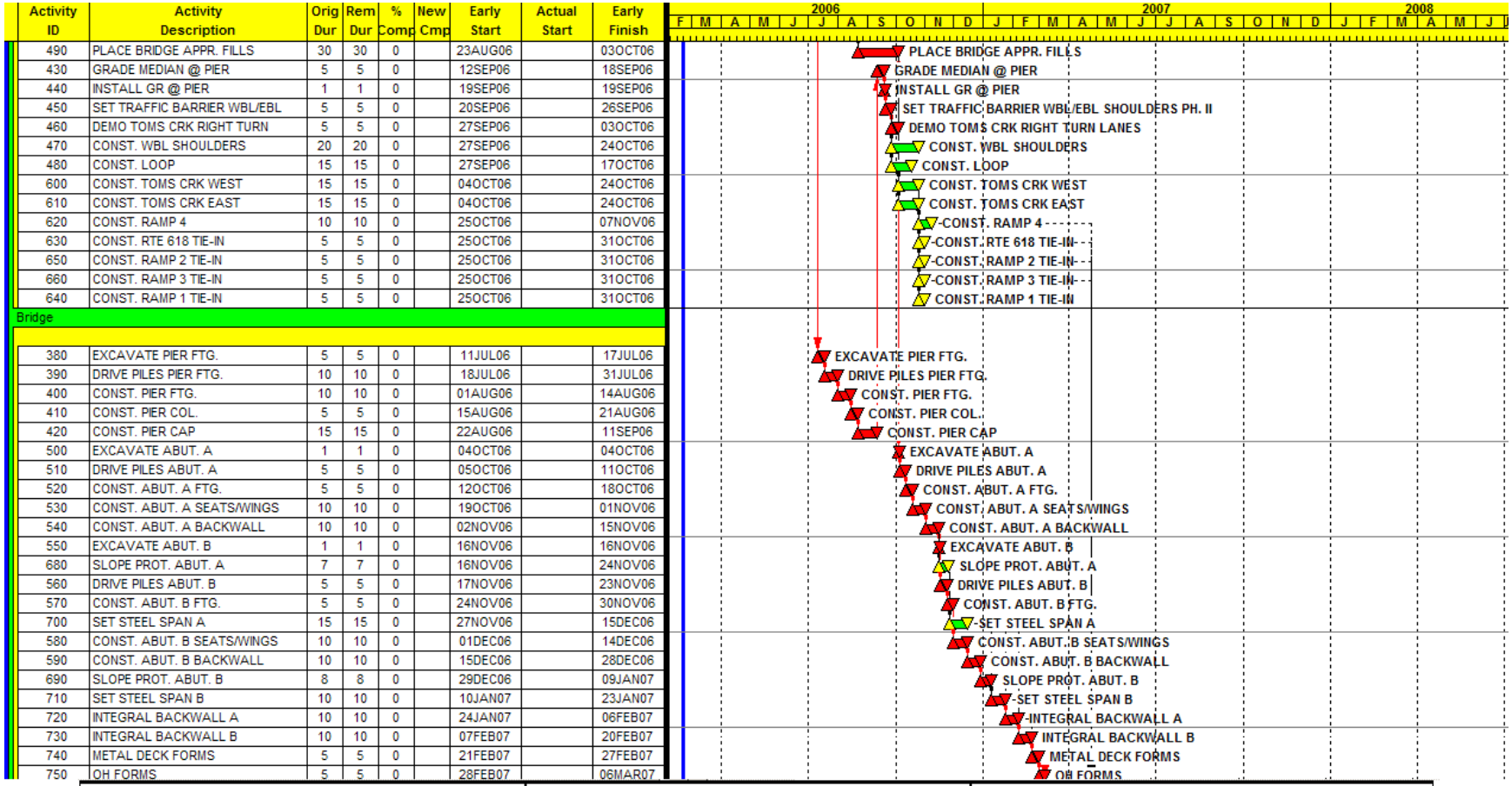
Early Bar
Progress Bar
Critical Activity

BB01 Sheet 1 of 3

English Construction Co., Inc.

Updated Construction Progress Sched.

Classic Schedule Layout



Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	New Cmp	Early Start	Actual Start	Early Finish
490	PLACE BRIDGE APPR. FILLS	30	30	0		23AUG06		03OCT06
430	GRADE MEDIAN @ PIER	5	5	0		12SEP06		18SEP06
440	INSTALL GR @ PIER	1	1	0		19SEP06		19SEP06
450	SET TRAFFIC BARRIER WBL/EBL	5	5	0		20SEP06		26SEP06
460	DEMO TOMS CRK RIGHT TURN	5	5	0		27SEP06		03OCT06
470	CONST. WBL SHOULDERS	20	20	0		27SEP06		24OCT06
480	CONST. LOOP	15	15	0		27SEP06		17OCT06
600	CONST. TOMS CRK WEST	15	15	0		04OCT06		24OCT06
610	CONST. TOMS CRK EAST	15	15	0		04OCT06		24OCT06
620	CONST. RAMP 4	10	10	0		25OCT06		07NOV06
630	CONST. RTE 618 TIE-IN	5	5	0		25OCT06		31OCT06
650	CONST. RAMP 2 TIE-IN	5	5	0		25OCT06		31OCT06
660	CONST. RAMP 3 TIE-IN	5	5	0		25OCT06		31OCT06
640	CONST. RAMP 1 TIE-IN	5	5	0		25OCT06		31OCT06
Bridge								
380	EXCAVATE PIER FTG.	5	5	0		11JUL06		17JUL06
390	DRIVE PILES PIER FTG.	10	10	0		18JUL06		31JUL06
400	CONST. PIER FTG.	10	10	0		01AUG06		14AUG06
410	CONST. PIER COL.	5	5	0		15AUG06		21AUG06
420	CONST. PIER CAP	15	15	0		22AUG06		11SEP06
500	EXCAVATE ABUT. A	1	1	0		04OCT06		04OCT06
510	DRIVE PILES ABUT. A	5	5	0		05OCT06		11OCT06
520	CONST. ABUT. A FTG.	5	5	0		12OCT06		18OCT06
530	CONST. ABUT. A SEATS/WINGS	10	10	0		19OCT06		01NOV06
540	CONST. ABUT. A BACKWALL	10	10	0		02NOV06		15NOV06
550	EXCAVATE ABUT. B	1	1	0		16NOV06		16NOV06
680	SLOPE PROT. ABUT. A	7	7	0		16NOV06		24NOV06
560	DRIVE PILES ABUT. B	5	5	0		17NOV06		23NOV06
570	CONST. ABUT. B FTG.	5	5	0		24NOV06		30NOV06
700	SET STEEL SPAN A	15	15	0		27NOV06		15DEC06
580	CONST. ABUT. B SEATS/WINGS	10	10	0		01DEC06		14DEC06
590	CONST. ABUT. B BACKWALL	10	10	0		15DEC06		28DEC06
690	SLOPE PROT. ABUT. B	8	8	0		29DEC06		09JAN07
710	SET STEEL SPAN B	10	10	0		10JAN07		23JAN07
720	INTEGRAL BACKWALL A	10	10	0		24JAN07		06FEB07
730	INTEGRAL BACKWALL B	10	10	0		07FEB07		20FEB07
740	METAL DECK FORMS	5	5	0		21FEB07		27FEB07
750	OH FORMS	5	5	0		28FEB07		06MAR07

Start Date	13FEB06
Finish Date	25OCT07
Data Date	20FEB06
Run Date	13NOV07 12:26

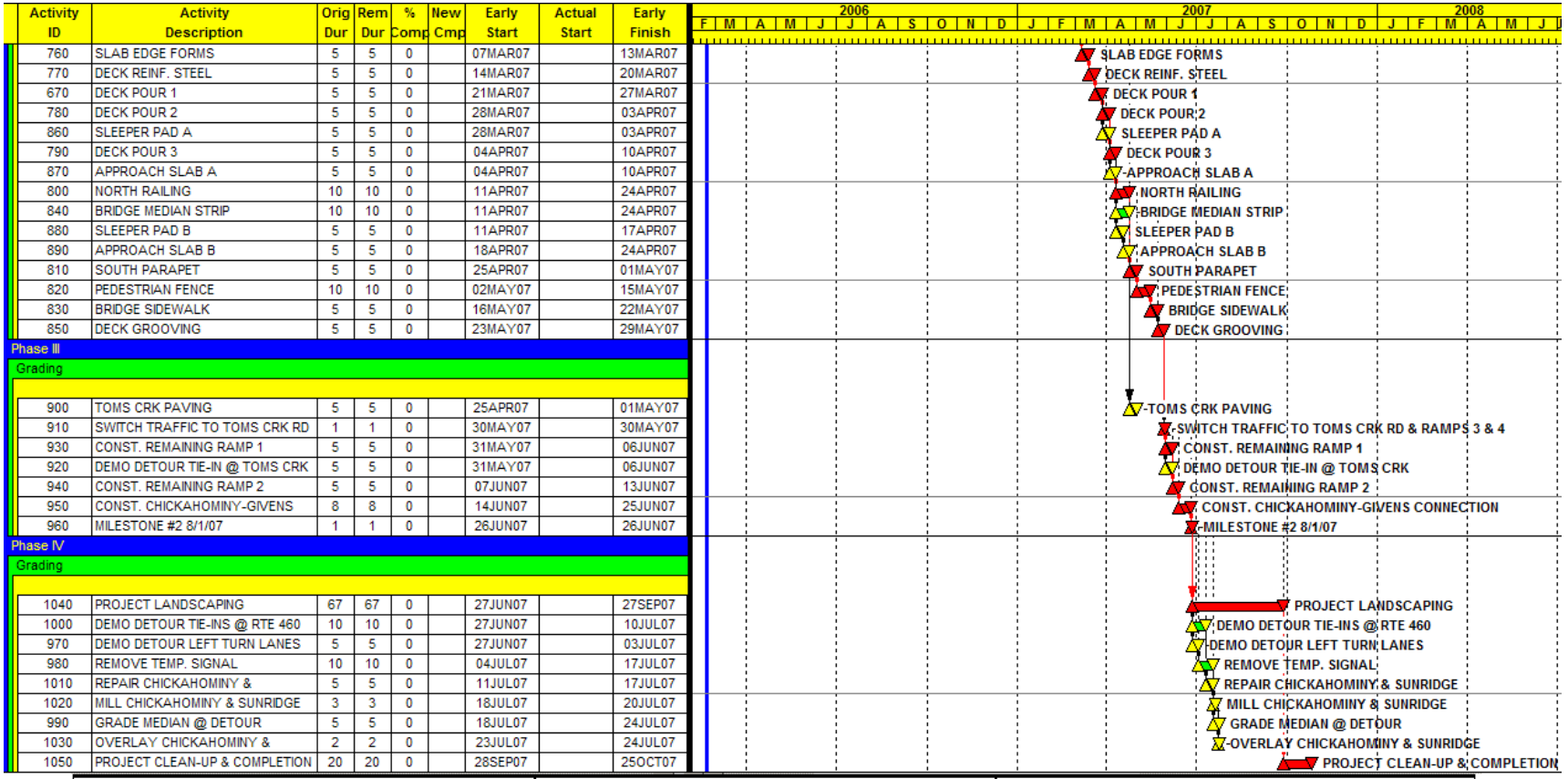
Early Bar
Progress Bar
Critical Activity

BB01 Sheet 2 of 3

English Construction Co., Inc.

Updated Construction Progress Sched.

Classic Schedule Layout



Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	New Cmp	Early Start	Actual Start	Early Finish
760	SLAB EDGE FORMS	5	5	0		07MAR07		13MAR07
770	DECK REINF. STEEL	5	5	0		14MAR07		20MAR07
670	DECK POUR 1	5	5	0		21MAR07		27MAR07
780	DECK POUR 2	5	5	0		28MAR07		03APR07
860	SLEEPER PAD A	5	5	0		28MAR07		03APR07
790	DECK POUR 3	5	5	0		04APR07		10APR07
870	APPROACH SLAB A	5	5	0		04APR07		10APR07
800	NORTH RAILING	10	10	0		11APR07		24APR07
840	BRIDGE MEDIAN STRIP	10	10	0		11APR07		24APR07
880	SLEEPER PAD B	5	5	0		11APR07		17APR07
890	APPROACH SLAB B	5	5	0		18APR07		24APR07
810	SOUTH PARAPET	5	5	0		25APR07		01MAY07
820	PEDESTRIAN FENCE	10	10	0		02MAY07		15MAY07
830	BRIDGE SIDEWALK	5	5	0		16MAY07		22MAY07
850	DECK GROOVING	5	5	0		23MAY07		29MAY07
Phase III								
Grading								
900	TOMS CRK PAVING	5	5	0		25APR07		01MAY07
910	SWITCH TRAFFIC TO TOMS CRK RD	1	1	0		30MAY07		30MAY07
930	CONST. REMAINING RAMP 1	5	5	0		31MAY07		06JUN07
920	DEMO DETOUR TIE-IN @ TOMS CRK	5	5	0		31MAY07		06JUN07
940	CONST. REMAINING RAMP 2	5	5	0		07JUN07		13JUN07
950	CONST. CHICKAHOMINY-GIVENS	8	8	0		14JUN07		25JUN07
960	MILESTONE #2 8/1/07	1	1	0		26JUN07		26JUN07
Phase IV								
Grading								
1040	PROJECT LANDSCAPING	67	67	0		27JUN07		27SEP07
1000	DEMO DETOUR TIE-INS @ RTE 460	10	10	0		27JUN07		10JUL07
970	DEMO DETOUR LEFT TURN LANES	5	5	0		27JUN07		03JUL07
980	REMOVE TEMP. SIGNAL	10	10	0		04JUL07		17JUL07
1010	REPAIR CHICKAHOMINY &	5	5	0		11JUL07		17JUL07
1020	MILL CHICKAHOMINY & SUNRIDGE	3	3	0		18JUL07		20JUL07
990	GRADE MEDIAN @ DETOUR	5	5	0		18JUL07		24JUL07
1030	OVERLAY CHICKAHOMINY &	2	2	0		23JUL07		24JUL07
1050	PROJECT CLEAN-UP & COMPLETION	20	20	0		28SEP07		25OCT07

Start Date	13FEB06
Finish Date	25OCT07
Data Date	20FEB06
Run Date	13NOV07 12:26

Early Bar
Progress Bar
Critical Activity

BB01 Sheet 3 of 3

English Construction Co., Inc.

Updated Construction Progress Sched.

Classic Schedule Layout

Tom's Creek Interchange Project - Pro Forma Pay Request
August 2007 (Project Month 19)
Page 1 of 6

Bid Items				Month 19 Data			
Description	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Mobilization	1.00	ls	$450,000.00	0.00	1.00	$0.00	$450,000.00
Construction Surveying	1.00	ls	$75,000.00	0.05	1.00	$3,750.00	$75,000.00
Clearing and Grubbing	1.00	ls	$419,000.00	0.00	1.00	$0.00	$419,000.00
Regular Excavation	65,207.00	cu m	$13.75	0.00	65,207.00	$0.00	$896,596.25
Borrow Excavation	44,090.00	cu m	$9.50	0.00	44,090.00	$0.00	$418,855.00
Minor Structure Excav. Pipe Culvert	303.00	cu m	$15.00	0.00	303.00	$0.00	$4,545.00
Bedding Material Aggr. No. 25 or 26	91.00	mton	$18.00	0.00	91.00	$0.00	$1,638.00
Concrete Class 20 Misc.	42.00	cu m	$996.00	0.00	42.00	$0.00	$41,832.00
Flowable Backfill	22.00	cu m	$250.00	0.00	22.00	$0.00	$5,500.00
Underdrain UD-4	1,316.00	m	$31.00	0.00	1,316.00	$0.00	$40,796.00
Comb. Underdrain CD-1	13.00	m	$55.00	0.00	13.00	$0.00	$715.00
Comb. Underdrain CD-2	89.00	m	$54.00	0.00	89.00	$0.00	$4,806.00
120mm Outlet Pipe	126.00	m	$44.00	0.00	126.00	$0.00	$5,544.00
Endwall EW-12	15.00	ea	$358.00	0.00	15.00	$0.00	$5,370.00
150mm Pipe	18.00	m	$65.00	0.00	18.00	$0.00	$1,170.00
375mm Pipe	165.00	m	$113.00	0.00	165.00	$0.00	$18,645.00
375mm Conc. Pipe	727.00	m	$123.00	0.00	727.00	$0.00	$89,421.00
450mm Conc. Pipe	38.00	m	$179.00	0.00	38.00	$0.00	$6,802.00
600mm Conc. Pipe	75.00	m	$226.00	0.00	75.00	$0.00	$16,950.00
750mm Conc. Pipe	92.00	m	$315.00	0.00	92.00	$0.00	$28,980.00
900mm Conc. Pipe	65.00	m	$468.00	0.00	65.00	$0.00	$30,420.00
1200mm Conc. Pipe	13.00	m	$646.00	0.00	13.00	$0.00	$8,398.00
Jacked 1500mm Pipe	68.00	m	$7,300.00	0.00	68.00	$0.00	$496,400.00
1500mm Conc. Pipe	68.00	m	$925.00	0.00	68.00	$0.00	$62,900.00
375mm End Section ES-1	2.00	ea	$445.00	0.00	2.00	$0.00	$890.00
600mm End Section ES-1	2.00	ea	$665.00	0.00	2.00	$0.00	$1,330.00
Drop Inlet DI-1	1.00	ea	$2,000.00	0.00	1.00	$0.00	$2,000.00
Drop Inlet DI-3A	11.00	ea	$2,200.00	0.00	11.00	$0.00	$24,200.00
Drop Inlet DI-3AA	3.00	ea	$3,100.00	0.00	3.00	$0.00	$9,300.00
Drop Inlet DI-3B, L= 1.8m	2.00	ea	$2,600.00	0.00	2.00	$0.00	$5,200.00
Drop Inlet DI-3B, L= 2.4m	7.00	ea	$2,900.00	0.00	7.00	$0.00	$20,300.00
Drop Inlet DI-3B, L= 3.0m	4.00	ea	$3,700.00	0.00	4.00	$0.00	$14,800.00
Drop Inlet DI-3BB, L= 2.4m	3.00	ea	$5,100.00	0.00	3.00	$0.00	$15,300.00
Drop Inlet DI-3C, L= 3.0m	1.00	ea	$3,400.00	0.00	1.00	$0.00	$3,400.00
Drop Inlet DI-3CC, L= 3.0m	1.00	ea	$4,800.00	0.00	1.00	$0.00	$4,800.00
Drop Inlet DI-3DD	2.00	ea	$3,500.00	0.00	2.00	$0.00	$7,000.00
Drop Inlet DI-3EE, L= 2.4m	2.00	ea	$4,800.00	0.00	2.00	$0.00	$9,600.00
Drop Inlet DI-7	2.00	ea	$2,800.00	0.00	2.00	$0.00	$5,600.00
Drop Inlet DI-14C Type I, L= 3.0m	1.00	ea	$4,800.00	0.00	1.00	$0.00	$4,800.00
Drop Inlet DI-12, L= 2.4m	1.00	ea	$4,700.00	0.00	1.00	$0.00	$4,700.00
Drop Inlet DI-12, L= 3.0m	3.00	ea	$5,400.00	0.00	3.00	$0.00	$16,200.00
Drop Inlet DI-12A, L= 2.4m	3.00	ea	$4,800.00	0.00	3.00	$0.00	$14,400.00
Drop Inlet DI-12C, L= 1.2m	1.00	ea	$2,500.00	0.00	1.00	$0.00	$2,500.00
Drop Inlet DI-12C, L= 1.8m	1.00	ea	$3,600.00	0.00	1.00	$0.00	$3,600.00
Drop Inlet DI-12C, L= 2.4m	0.00	ea	$4,200.00	1.00	1.00	$4,200.00	$4,200.00

Tom's Creek Interchange Project - Pro Forma Pay Request
August 2007 (Project Month 19)
Page 2 of 6

Bid Items				Month 19 Data			
Description	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Drop Inlet DI-12C, L= 3.0m	1.00	ea	$4,500.00	0.00	1.00	$0.00	$4,500.00
Drop Inlet DI-13 Type I	4.00	ea	$2,900.00	0.00	4.00	$0.00	$11,600.00
Drop Inlet DI-13, Type II	1.00	ea	$3,600.00	0.00	1.00	$0.00	$3,600.00
Manhole MH-1 or 2	42.00	m	$1,400.00	0.00	42.00	$0.00	$58,800.00
Frame and Cover MH-1	12.00	ea	$350.00	0.00	12.00	$0.00	$4,200.00
Erosion Control Stone Class I, EC-1	128.00	mton	$34.00	0.00	128.00	$0.00	$4,352.00
Erosion Control Stone Class II, EC-1	46.00	mton	$40.00	0.00	46.00	$0.00	$1,840.00
Paved Ditch PG-2A	238.00	sq m	$78.00	0.00	238.00	$0.00	$18,564.00
Slope Drain	20.00	ea	$250.00	0.00	20.00	$0.00	$5,000.00
Aggragate Material No. 1	6,730.00	mton	$13.50	0.00	6,730.00	$0.00	$90,855.00
Aggragate Material No. 25 or 26	50.00	mton	$50.00	0.00	50.00	$0.00	$2,500.00
Aggragate Base Material Type I No. 21B	17,242.00	mton	$14.00	0.00	17,242.00	$0.00	$241,388.00
Aggragate Material #57	42.00	mton	$50.00	0.00	42.00	$0.00	$2,100.00
Asphalt Concrete Base Course Ty. BM-25.0	10,158.00	mton	$58.00	67.00	10,158.00	$3,886.00	$589,164.00
Flexible Pavement Planning	16,721.00	sq m	$1.80	0.00	16,721.00	$0.00	$30,097.80
Asphalt Concrete Type SM-9.5D	4,763.00	mton	$70.00	250.00	4,763.00	$17,500.00	$333,410.00
Concrete Class 30 Bridge Appr. Slab	115.00	cu m	$430.00	0.00	115.00	$0.00	$49,450.00
Reinforced Steel Bridge Appr. Slab	13,392.00	kg	$1.50	0.00	13,392.00	$0.00	$20,088.00
Prefab. Elastic Joint Sealer 75mm	44.00	m	$165.00	0.00	44.00	$0.00	$7,260.00
Standard Curb CG-2	233.00	m	$61.00	0.00	233.00	$0.00	$14,213.00
Asphalt Concrete Curb Type MC-3B	379.00	m	$33.00	0.00	379.00	$0.00	$12,507.00
Asphalt Concrete, Curb Backup Material	40.00	mton	$127.00	0.00	40.00	$0.00	$5,079.37
Standard Combination Curb and Gutter CG-6	836.00	m	$65.00	0.00	836.00	$0.00	$54,340.00
Radial Combination Curb and Gutter CG-6	388.00	m	$68.00	0.00	388.00	$0.00	$26,384.00
Entrance Gutter CG-9D	59.00	sq m	$105.00	0.00	59.00	$0.00	$6,195.00
CG-12 Detectable Warning Surface	30.00	sq m	$395.00	0.00	30.00	$0.00	$11,850.00
Right of Way Monument RM-2	60.00	ea	$25.00	0.00	60.00	$0.00	$1,500.00
Hydraulic Cement Concrete Sidewalk 100mm	1,085.00	sq m	$44.00	0.00	1,085.00	$0.00	$47,740.00
Guardrail Terminal GR-6 (NCHRP 350)	8.00	m	$275.00	0.00	8.00	$0.00	$2,200.00
Guardrail Terminal GR-7 (NCHRP 350)	13.00	ea	$2,085.00	0.00	13.00	$0.00	$27,105.00
Guardrail Terminal GR-11	12.00	ea	$603.00	0.00	12.00	$0.00	$7,236.00
Guardrail GR-2	2,180.00	m	$52.00	0.00	2,180.00	$0.00	$113,360.00
Radial Guardrail GR-2	111.00	m	$55.00	0.00	111.00	$0.00	$6,105.00
Alternate Breakaway Cable Terminal (GR-9)	5.00	ea	$2,200.00	0.00	5.00	$0.00	$11,000.00
Fixed Object Attach. GR-FOA-1 Type I	1.00	ea	$1,980.00	0.00	1.00	$0.00	$1,980.00
Fixed Object Attach. GR-FOA-1 Type II	1.00	ea	$343.00	0.00	1.00	$0.00	$343.00
Fixed Object Attach. GR-FOA-2 Type I	3.00	ea	$2,090.00	0.00	3.00	$0.00	$6,270.00
Fixed Object Attach. GR-FOA-2 Type II	1.00	ea	$343.00	0.00	1.00	$0.00	$343.00
Median Barrier MB-3	191.00	m	$82.00	0.00	191.00	$0.00	$15,662.00
Median Barrier MB-7E	12.00	m	$660.00	0.00	12.00	$0.00	$7,920.00
Median Barrier MB-8A Type I	77.00	m	$660.00	0.00	77.00	$0.00	$50,820.00
Impact Atten. (TL-3, >70km/hr Design Spec.)	2.00	ea	$18,000.00	0.00	2.00	$0.00	$36,000.00
Impact Attenuator Service Type II-12	8.00	ea	$6,000.00	0.00	8.00	$0.00	$48,000.00
Geotexile Drainage Fabric	97.00	sq m	$6.00	0.00	97.00	$0.00	$582.00
Reinforcing Steel	1,465.00	kg	$1.50	0.00	1,465.00	$0.00	$2,197.50

Tom's Creek Interchange Project - Pro Forma Pay Request
August 2007 (Project Month 19)
Page 2 of 6

Bid Items				Month 19 Data			
Description	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Drop Inlet DI-12C, L= 3.0m	1.00	ea	$4,500.00	0.00	1.00	$0.00	$4,500.00
Drop Inlet DI-13 Type I	4.00	ea	$2,900.00	0.00	4.00	$0.00	$11,600.00
Drop Inlet DI-13, Type II	1.00	ea	$3,600.00	0.00	1.00	$0.00	$3,600.00
Manhole MH-1 or 2	42.00	m	$1,400.00	0.00	42.00	$0.00	$58,800.00
Frame and Cover MH-1	12.00	ea	$350.00	0.00	12.00	$0.00	$4,200.00
Erosion Control Stone Class I, EC-1	128.00	mton	$34.00	0.00	128.00	$0.00	$4,352.00
Erosion Control Stone Class II, EC-1	46.00	mton	$40.00	0.00	46.00	$0.00	$1,840.00
Paved Ditch PG-2A	238.00	sq m	$78.00	0.00	238.00	$0.00	$18,564.00
Slope Drain	20.00	ea	$250.00	0.00	20.00	$0.00	$5,000.00
Aggragate Material No. 1	6,730.00	mton	$13.50	0.00	6,730.00	$0.00	$90,855.00
Aggragate Material No. 25 or 26	50.00	mton	$50.00	0.00	50.00	$0.00	$2,500.00
Aggragate Base Material Type I No. 21B	17,242.00	mton	$14.00	0.00	17,242.00	$0.00	$241,388.00
Aggragate Material #57	42.00	mton	$50.00	0.00	42.00	$0.00	$2,100.00
Asphalt Concrete Base Course Ty. BM-25.0	10,158.00	mton	$58.00	67.00	10,158.00	$3,886.00	$589,164.00
Flexible Pavement Planning	16,721.00	sq m	$1.80	0.00	16,721.00	$0.00	$30,097.80
Asphalt Concrete Type SM-9.5D	4,763.00	mton	$70.00	250.00	4,763.00	$17,500.00	$333,410.00
Concrete Class 30 Bridge Appr. Slab	115.00	cu m	$430.00	0.00	115.00	$0.00	$49,450.00
Reinforced Steel Bridge Appr. Slab	13,392.00	kg	$1.50	0.00	13,392.00	$0.00	$20,088.00
Prefab. Elastic Joint Sealer 75mm	44.00	m	$165.00	0.00	44.00	$0.00	$7,260.00
Standard Curb CG-2	233.00	m	$61.00	0.00	233.00	$0.00	$14,213.00
Asphalt Concrete Curb Type MC-3B	379.00	m	$33.00	0.00	379.00	$0.00	$12,507.00
Asphalt Concrete, Curb Backup Material	40.00	mton	$127.00	0.00	40.00	$0.00	$5,079.37
Standard Combination Curb and Gutter CG-6	836.00	m	$65.00	0.00	836.00	$0.00	$54,340.00
Radial Combination Curb and Gutter CG-6	388.00	m	$68.00	0.00	388.00	$0.00	$26,384.00
Entrance Gutter CG-9D	59.00	sq m	$105.00	0.00	59.00	$0.00	$6,195.00
CG-12 Detectable Warning Surface	30.00	sq m	$395.00	0.00	30.00	$0.00	$11,850.00
Right of Way Monument RM-2	60.00	ea	$25.00	0.00	60.00	$0.00	$1,500.00
Hydraulic Cement Concrete Sidewalk 100mm	1,085.00	sq m	$44.00	0.00	1,085.00	$0.00	$47,740.00
Guardrail Terminal GR-6 (NCHRP 350)	8.00	m	$275.00	0.00	8.00	$0.00	$2,200.00
Guardrail Terminal GR-7 (NCHRP 350)	13.00	ea	$2,085.00	0.00	13.00	$0.00	$27,105.00
Guardrail Terminal GR-11	12.00	ea	$603.00	0.00	12.00	$0.00	$7,236.00
Guardrail GR-2	2,180.00	m	$52.00	0.00	2,180.00	$0.00	$113,360.00
Radial Guardrail GR-2	111.00	m	$55.00	0.00	111.00	$0.00	$6,105.00
Alternate Breakaway Cable Terminal (GR-9)	5.00	ea	$2,200.00	0.00	5.00	$0.00	$11,000.00
Fixed Object Attach. GR-FOA-1 Type I	1.00	ea	$1,980.00	0.00	1.00	$0.00	$1,980.00
Fixed Object Attach. GR-FOA-1 Type II	1.00	ea	$343.00	0.00	1.00	$0.00	$343.00
Fixed Object Attach. GR-FOA-2 Type I	3.00	ea	$2,090.00	0.00	3.00	$0.00	$6,270.00
Fixed Object Attach. GR-FOA-2 Type II	1.00	ea	$343.00	0.00	1.00	$0.00	$343.00
Median Barrier MB-3	191.00	m	$82.00	0.00	191.00	$0.00	$15,662.00
Median Barrier MB-7E	12.00	m	$660.00	0.00	12.00	$0.00	$7,920.00
Median Barrier MB-8A Type I	77.00	m	$660.00	0.00	77.00	$0.00	$50,820.00
Impact Atten. (TL-3, >70km/hr Design Spec.)	2.00	ea	$18,000.00	0.00	2.00	$0.00	$36,000.00
Impact Attenuator Service Type II-12	8.00	ea	$6,000.00	0.00	8.00	$0.00	$48,000.00
Geotexile Drainage Fabric	97.00	sq m	$6.00	0.00	97.00	$0.00	$582.00
Reinforcing Steel	1,465.00	kg	$1.50	0.00	1,465.00	$0.00	$2,197.50

Tom's Creek Interchange Project - Pro Forma Pay Request
August 2007 (Project Month 19)
Page 4 of 6

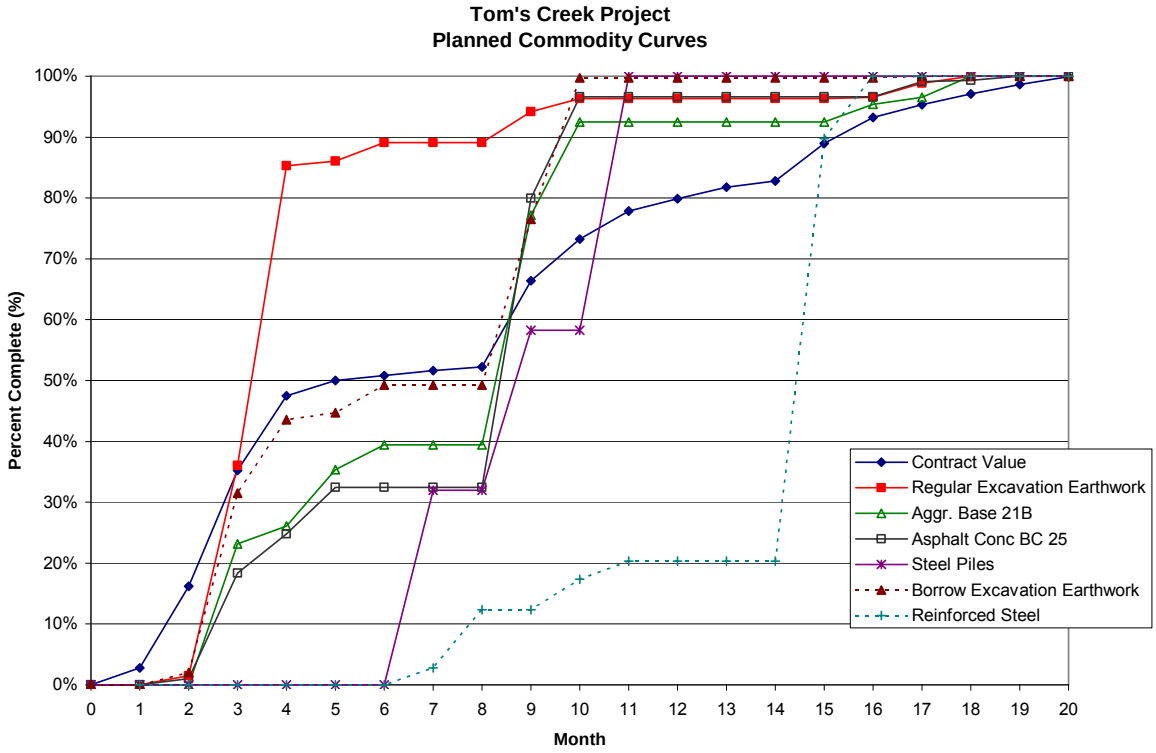
Bid Items				Month 19 Data			
Description	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Remulching	87.50	cu m	$42.00	61.25	87.50	$2,572.50	$3,675.00
Watering	85.00	unit	$110.00	59.50	85.00	$6,545.00	$9,350.00
Plant or Tree American Holly (Female), H= 180cm	81.50	ea	$388.00	57.05	81.50	$22,135.40	$31,622.00
Plant or Tree 'Brilliantissma' Choke Berry, #3 Cont.	277.00	ea	$34.00	193.90	277.00	$6,592.60	$9,418.00
Plant or Tree Ceylon Daffodil	616.00	ea	$3.50	431.20	616.00	$1,509.20	$2,156.00
Plant or Tree Eastern Red Cedar, H= 125cm	107.50	ea	$121.00	75.25	107.50	$9,105.25	$13,007.50
Plant or Tree Eastern Redbud, Multi-stem, H=125cm	30.00	ea	$121.00	21.00	30.00	$2,541.00	$3,630.00
Plant or Tree Happy Return - Daylilly, #1 Cont.	326.50	ea	$12.00	228.55	326.50	$2,742.60	$3,918.00
Plant or Tree Japanese Cedar, H= 180cm	27.50	ea	$224.00	19.25	27.50	$4,312.00	$6,160.00
Plant or Tree Norway Spruce, H= 180cm	11.00	ea	$224.00	7.70	11.00	$1,724.80	$2,464.00
Plant or Tree Red Sunset Maple Clump, H= 250cm	21.50	ea	$224.00	15.05	21.50	$3,371.20	$4,816.00
Plant or Tree Serviceberry Clump, H= 110cm	32.50	ea	$207.00	22.75	32.50	$4,709.25	$6,727.50
Plant or Tree Sherwood Glossy Abelia, #3 Cont.	30.50	ea	$45.00	21.35	30.50	$960.75	$1,372.50
Plant or Tree Summit Ash, 40mm Cal.	15.00	ea	$194.00	10.50	15.00	$2,037.00	$2,910.00
Plant or Tree Willow Oak Specimen, 20mm Cal.	4.50	ea	$183.00	3.15	4.50	$576.45	$823.50
Landscape Oversize Planting Pit	4.50	ea	$94.00	3.15	4.50	$296.10	$423.00
Landscape Removable Bollard	0.50	ea	$1,000.00	0.35	0.50	$350.00	$500.00
Vegetation Control Weeding	5.00	unit	$4,620.00	3.50	5.00	$16,170.00	$23,100.00
20mm Water Service Line	10.00	m	$165.00	0.00	10.00	$0.00	$1,650.00
150mm DI Water Main	14.00	m	$185.00	0.00	14.00	$0.00	$2,590.00
300mm DI Water Main	157.00	m	$410.00	0.00	157.00	$0.00	$64,370.00
150mm Gate Valve & Box	3.00	ea	$900.00	0.00	3.00	$0.00	$2,700.00
Fire Hydrant	2.00	ea	$3,200.00	0.00	2.00	$0.00	$6,400.00
20mm Water Meter & Box	3.00	ea	$750.00	0.00	3.00	$0.00	$2,250.00
200mm DI Sanitation Sewer Pipe	25.00	m	$720.00	0.00	25.00	$0.00	$18,000.00
Sanitary Sewar Manhole	9.00	m	$950.00	0.00	9.00	$0.00	$8,550.00
Manhole Frame & Cover F&C-1	3.00	ea	$400.00	0.00	3.00	$0.00	$1,200.00
Road Edge Delineator ED-3, Type II, D-1	72.00	ea	$46.00	0.00	72.00	$0.00	$3,312.00
Road Edge Delineator ED-3, Type II, D-2	20.00	ea	$46.00	0.00	20.00	$0.00	$920.00
Sign Panel	149.00	sq m	$289.00	0.00	149.00	$0.00	$43,061.00
Sign Post Wood 100mm x 100mm	165.00	m	$29.00	0.00	165.00	$0.00	$4,785.00
Sign Post Wood 150mm x 150mm	124.00	m	$29.00	0.00	124.00	$0.00	$3,596.00
Sign Post Steel 100mm	25.00	m	$202.00	0.00	25.00	$0.00	$5,050.00
Concrete Foundation, SSP-V A 525mm Dia x 1350mm	6.00	ea	$693.00	0.00	6.00	$0.00	$4,158.00
Concrete Foundation Overhead Sign Structure	34.00	cu m	$1,155.00	0.00	34.00	$0.00	$39,270.00
Traffic Sign Post Wood 150mm x 200mm	48.00	m	$29.00	0.00	48.00	$0.00	$1,392.00
Traffic Sign Overhead Sign Structure Loc. No. 1	1.00	ea	$43,000.00	0.00	1.00	$0.00	$43,000.00
Traffic Sign Overhead Sign Structure Loc. No. 2	1.00	ea	$35,000.00	0.00	1.00	$0.00	$35,000.00
Traffic Sign Overhead Sign Structure Loc. No. 3	1.00	ea	$35,000.00	0.00	1.00	$0.00	$35,000.00
Traffic Sign Overhead Sign Structure Loc. No. 4	1.00	ea	$43,000.00	0.00	1.00	$0.00	$43,000.00
Controller	1.00	ea	$15,000.00	0.00	1.00	$0.00	$15,000.00
Electrical Service SE-3	1.00	ea	$704.00	0.00	1.00	$0.00	$704.00
Pedestal Pole PF-2 3m	1.00	ea	$642.00	0.00	1.00	$0.00	$642.00
Concrete Foundation Signal Pole	6.00	cu m	$1,525.00	0.00	6.00	$0.00	$9,150.00
Concrete Foundation PF-2	1.00	ea	$1,515.00	0.00	1.00	$0.00	$1,515.00

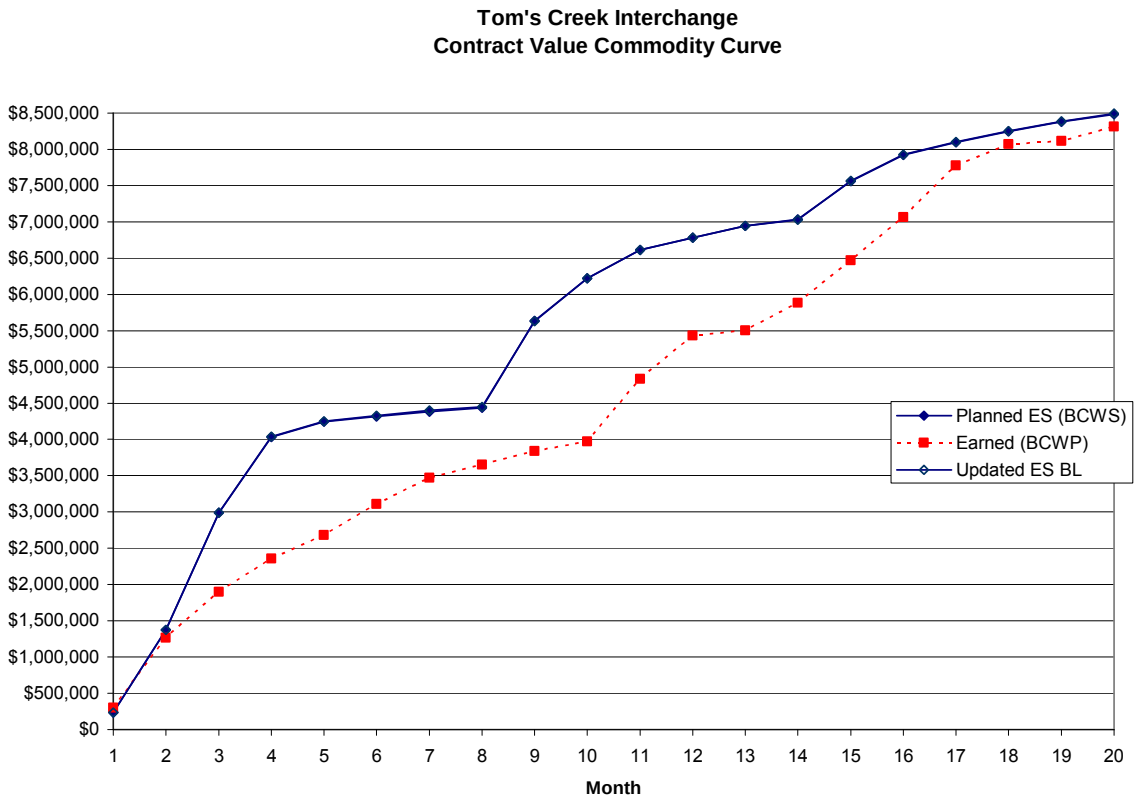
Tom's Creek Interchange Project - Pro Forma Pay Request
August 2007 (Project Month 19)
Page 5 of 6

Bid Items				Month 19 Data			
Description	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Concrete Foundation CD-1	1.00	ea	$2,500.00	0.00	1.00	$0.00	$2,500.00
Signal Pole MP-1 Comb. Lumin. One Arm 12m	1.00	ea	$6,100.00	0.00	1.00	$0.00	$6,100.00
Signal Pole MP-1 Com. Lum. Two Arms 11.5 16m	1.00	ea	$13,000.00	0.00	1.00	$0.00	$13,000.00
Loop Detector Amplifier	6.00	ea	$283.00	0.00	6.00	$0.00	$1,698.00
8/3 Conductor Cable	13.00	m	$22.00	0.00	13.00	$0.00	$286.00
12/1 Conductor Cable	423.00	m	$2.00	0.00	423.00	$0.00	$846.00
14/2 Conductor Cable	108.00	m	$3.30	0.00	108.00	$0.00	$356.40
14/3 Conductor Cable	112.00	m	$7.20	0.00	112.00	$0.00	$806.40
14/4 Conductor Cable	309.00	m	$5.50	0.00	309.00	$0.00	$1,699.50
14/2 Conductor Cable Shielded	160.00	m	$2.75	0.00	160.00	$0.00	$440.00
Pedestrian Pushbutton	2.00	ea	$195.00	0.00	2.00	$0.00	$390.00
Hanger Assembly SM-3, One Way	8.00	ea	$359.00	0.00	8.00	$0.00	$2,872.00
Hanger Assembly SM-2, One Way	1.00	ea	$367.00	0.00	1.00	$0.00	$367.00
Hanger Assembly SMB-3, One Way	1.00	ea	$300.00	0.00	1.00	$0.00	$300.00
Saw Cut	194.00	m	$19.00	0.00	194.00	$0.00	$3,686.00
Temporary Signalization	1.00	ls	$38,000.00	0.00	1.00	$0.00	$38,000.00
Traffic Signalization Remove Existing Signal Equipment	1.00	ls	$2,200.00	0.00	1.00	$0.00	$2,200.00
Traffic Signalization 50mm PVC Conduit	13.00	m	$44.00	0.00	13.00	$0.00	$572.00
Traffic Signalization Emergency Preemption Detector Cable	190.00	m	$4.40	0.00	190.00	$0.00	$836.00
Traffic Signalization Emergency Preemption One Way	3.00	ea	$3,218.00	0.00	3.00	$0.00	$9,654.00
Traffic Signalization Junction Box 3C	31.00	ea	$1,123.00	0.00	31.00	$0.00	$34,813.00
Traffic Signalization Junction Box 5C	1.00	ea	$3,009.00	0.00	1.00	$0.00	$3,009.00
Traffic Signalization Luminaire Arm 3.5m	2.00	ea	$547.00	0.00	2.00	$0.00	$1,094.00
Traffic Signalization Pedestrian Signal Head SP-7	4.00	ea	$992.00	0.00	4.00	$0.00	$3,968.00
Traffic Signalization Traffic Signal Head Sec. 305mm LED	25.00	ea	$324.00	0.00	25.00	$0.00	$8,100.00
Type A Pavement Line Marking 150mm	665.00	m	$3.60	0.00	665.00	$0.00	$2,393.98
Type A Pavement Line Marking 600mm	12.00	m	$18.00	0.00	12.00	$0.00	$216.00
Type B Class I Pavement Line Marking 100mm	7,232.00	m	$1.70	0.00	7,232.00	$0.00	$12,294.40
Type B Class I Pavement Line Marking 150mm	7,105.00	m	$2.50	0.00	7,105.00	$0.00	$17,762.49
Type B Class I Pavement Line Marking 200mm	1,500.00	m	$3.50	0.00	1,500.00	$0.00	$5,250.00
Type B Class I Pavement Line Marking 600mm	150.00	m	$36.00	0.00	150.00	$0.00	$5,400.00
Type B Class IV Pavement Line Marking 100mm	280.00	m	$11.00	0.00	280.00	$0.00	$3,080.00
Pavement Marking Performed 600mm x 900mm Yield Line	14.00	m	$65.00	0.00	14.00	$0.00	$910.00
Pavement Marking Elong. Arrow Type D	16.00	ea	$110.00	0.00	16.00	$0.00	$1,760.00
Eradication of Existing Pavement Marking	750.00	m	$4.00	0.00	750.00	$0.00	$3,000.00
Temporary Pavement Marker 1 Way	150.00	ea	$5.00	0.00	150.00	$0.00	$750.00
Pavement Message Marker Bicycle Lane Symbol	7.00	ea	$165.00	0.00	7.00	$0.00	$1,155.00
Pavement Message Marker Elongated Arrow Single	12.00	ea	$110.00	0.00	12.00	$0.00	$1,320.00
Construction Pavement Marking (Type E) 150mm	1,000.00	m	$10.00	0.00	1,000.00	$0.00	$10,000.00
Construction Pavement Marking (Type D, Cl. II) 100mm	4,237.00	m	$6.50	0.00	4,237.00	$0.00	$27,540.47
Construction Pavement Marking (Type D, Cl. II) 200mm	445.00	m	$12.00	0.00	445.00	$0.00	$5,339.94
Construction Pavement Marking (Type D, Cl. II) 600mm	36.00	m	$38.00	0.00	36.00	$0.00	$1,368.00
Construction Pavement Marking (Type f, Cl. II) 100mm	1,253.00	m	$2.40	0.00	1,253.00	$0.00	$3,007.19
6 Conductor Cable	3,200.00	m	$3.00	0.00	3,200.00	$0.00	$9,600.00
8 Conductor Cable	600.00	m	$2.20	0.00	600.00	$0.00	$1,320.00

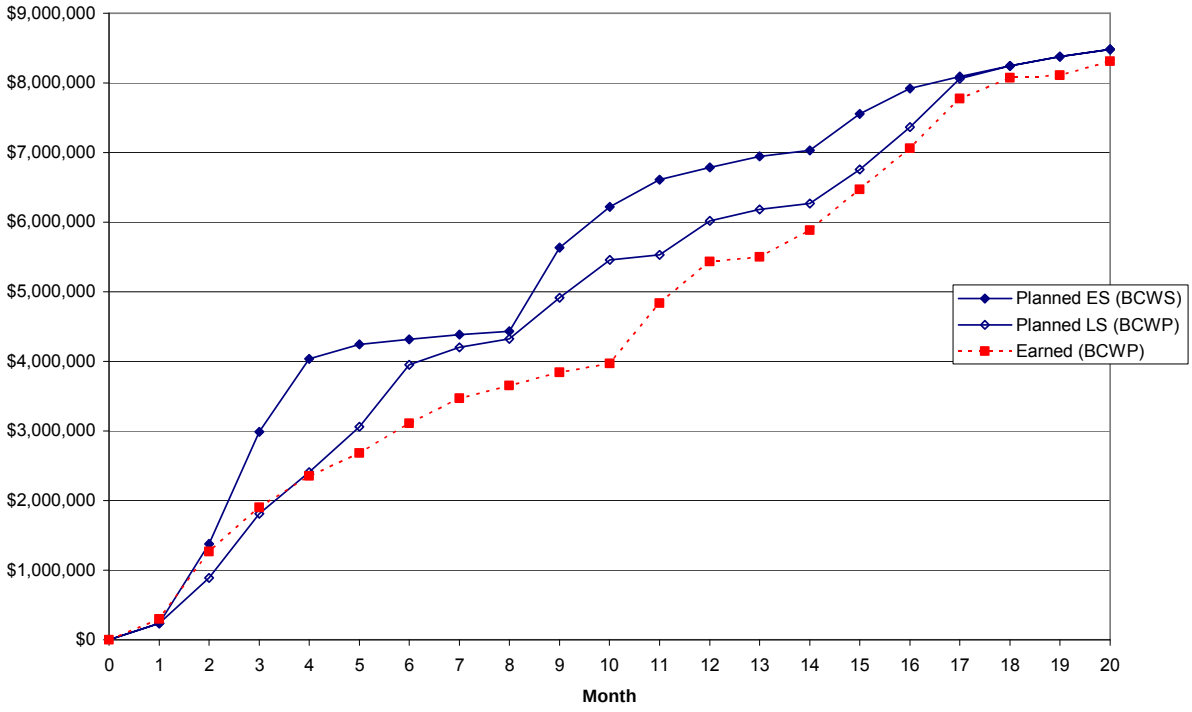
Tom's Creek Interchange Project - Pro Forma Pay Request
August 2007 (Project Month 19)
Page 6 of 6

Bid Items				Month 19 Data			
Description	Total Quantity Planned	Unit	Unit Price	Planned Qty This Period	Planned Qty To Date	Planned Value This Period	Planned Value To Date
Concrete Foundation LF-1 Type A	17.00	ea	$1,634.00	0.00	17.00	$0.00	$27,778.00
Lighting Pole LP-1 9m - 3.5m	12.00	ea	$1,724.00	0.00	12.00	$0.00	$20,688.00
Electrical Service SE-7 Type A	4.00	ea	$1,198.00	0.00	4.00	$0.00	$4,792.00
Control Center CCW-1 Type D	1.00	ea	$2,730.00	0.00	1.00	$0.00	$2,730.00
Luminaire 250watt H.P.S.	14.00	ea	$570.00	0.00	14.00	$0.00	$7,980.00
Electrical Ser. Grd. Electrode (3m)	24.00	ea	$152.00	0.00	24.00	$0.00	$3,648.00
25mm PVC Conduit	28.00	m	$32.00	0.00	28.00	$0.00	$896.00
50mm Conduit	1,475.00	m	$8.80	0.00	1,475.00	$0.00	$12,980.00
Trench Excavation ECI-1	960.00	m	$6.60	0.00	960.00	$0.00	$6,336.00
Test Bore	6.00	ea	$781.00	0.00	6.00	$0.00	$4,686.00
Lighting Electrical Service SE-9, Type B	1.00	ea	$6,889.00	0.00	1.00	$0.00	$6,889.00
Lighting 100mm Pipe Sleeve	125.00	m	$57.00	0.00	125.00	$0.00	$7,125.00
Lighting Trench Excavation ECI-2	125.00	m	$17.00	0.00	125.00	$0.00	$2,125.00
Concrete Class 30	357.30	cu m	$600.00	0.00	357.30	$0.00	$214,380.00
Bridge Deck Grooving	894.00	sq m	$3.50	0.00	894.00	$0.00	$3,129.00
Epoxy Coated Reinforced Steel	38,600.00	kg	$2.00	0.00	38,600.00	$0.00	$77,200.00
Structural Steel High Strength Plate Girders	164,300.00	kg	$3.74	0.00	164,300.00	$0.00	$614,000.00
Concrete Parapet	56.00	m	$400.00	0.00	56.00	$0.00	$22,400.00
Railing, Aluminum	56.00	m	$600.00	0.00	56.00	$0.00	$33,600.00
Structure Excavation	240.00	cu m	$100.00	0.00	240.00	$0.00	$24,000.00
Porous Backfill	15.00	cu m	$100.00	0.00	15.00	$0.00	$1,500.00
Pipe Underdrain 150mm	65.00	m	$33.00	0.00	65.00	$0.00	$2,145.00
Steel Piles 250mm	350.00	m	$110.00	0.00	350.00	$0.00	$38,500.00
Concrete Class 25	248.00	cu m	$600.00	0.00	248.00	$0.00	$148,800.00
Reinforced Steel	13,250.00	kg	$1.80	0.00	13,250.00	$0.00	$23,850.00
Concrete Slab Slope Protection 100mm	390.00	sq m	$65.00	0.00	390.00	$0.00	$25,350.00
Bridge Substructure Elastic Inclusion 250mm Thickness	49.00	sq m	$150.00	0.00	49.00	$0.00	$7,350.00
Pedestrian Fence 1.8m	56.00	m	$390.00	0.00	56.00	$0.00	$21,840.00
Pedestrian Fence Modified	56.00	m	$330.00	0.00	56.00	$0.00	$18,480.00
Pile Point for 250mm Steel Pile	84.00	ea	$100.00	0.00	84.00	$0.00	$8,400.00
Demolition of Building Parcel 001, D-1	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Demolition of Building Parcel 001, D-2	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Clearing of Parcel No. 001	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Clearing of Parcel No. 002	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Clearing of Parcel No. 003	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Clearing of Parcel No. 005	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Clearing of Parcel No. 007	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
Clearing of Parcel No. 011	1.00	ls	$1.00	0.00	1.00	$0.00	$1.00
					EARNED VALUE	**$137,126.90**	$8,324,151.58

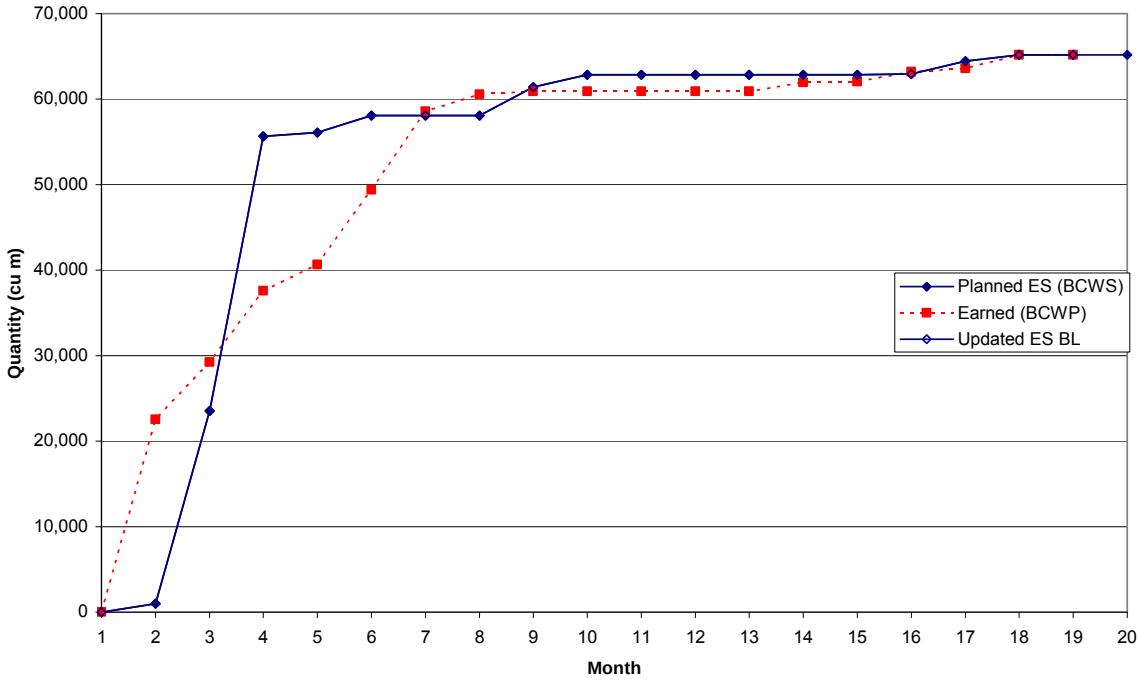

Tom's Creek Project
Planned Commodity Curves
Percent Complete (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Month
Contract Value
Regular Excavation Earthwork
Aggr. Base 21B
Asphalt Conc BC 25
Steel Piles
Borrow Excavation Earthwork
Reinforced Steel


Tom's Creek Interchange
Contract Value Commodity Curve
$8,500,000
$8,000,000
$7,500,000
$7,000,000
$6,500,000
$6,000,000
$5,500,000
$5,000,000
$4,500,000
$4,000,000
$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Month
Planned ES (BCWS)
Earned (BCWP)
Updated ES BL

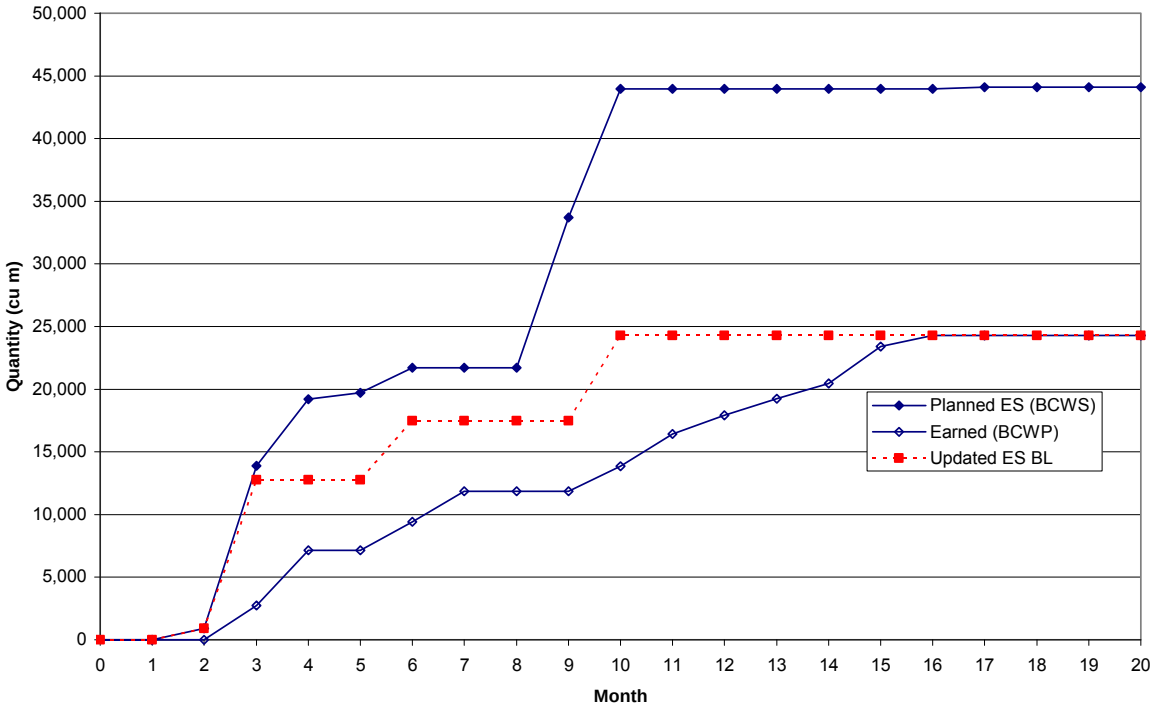
Tom's Creek Project
ES/LS Contract Value Commodity Curve



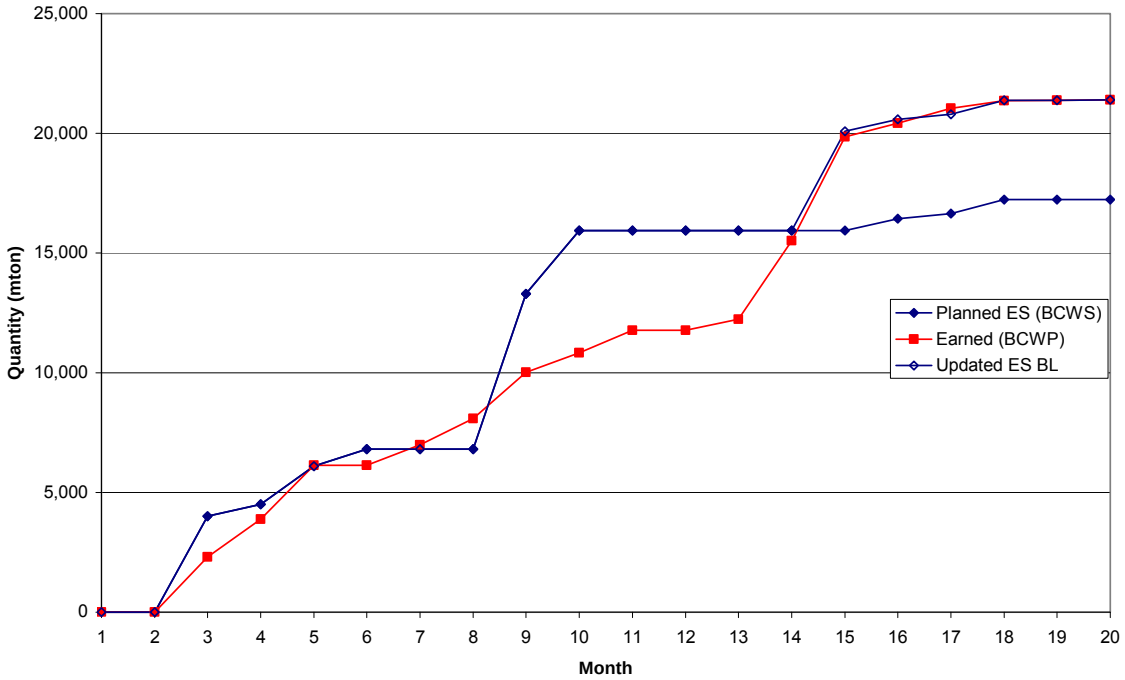
Tom's Creek Interchange
Regular Excavation Soil Commodity Curve



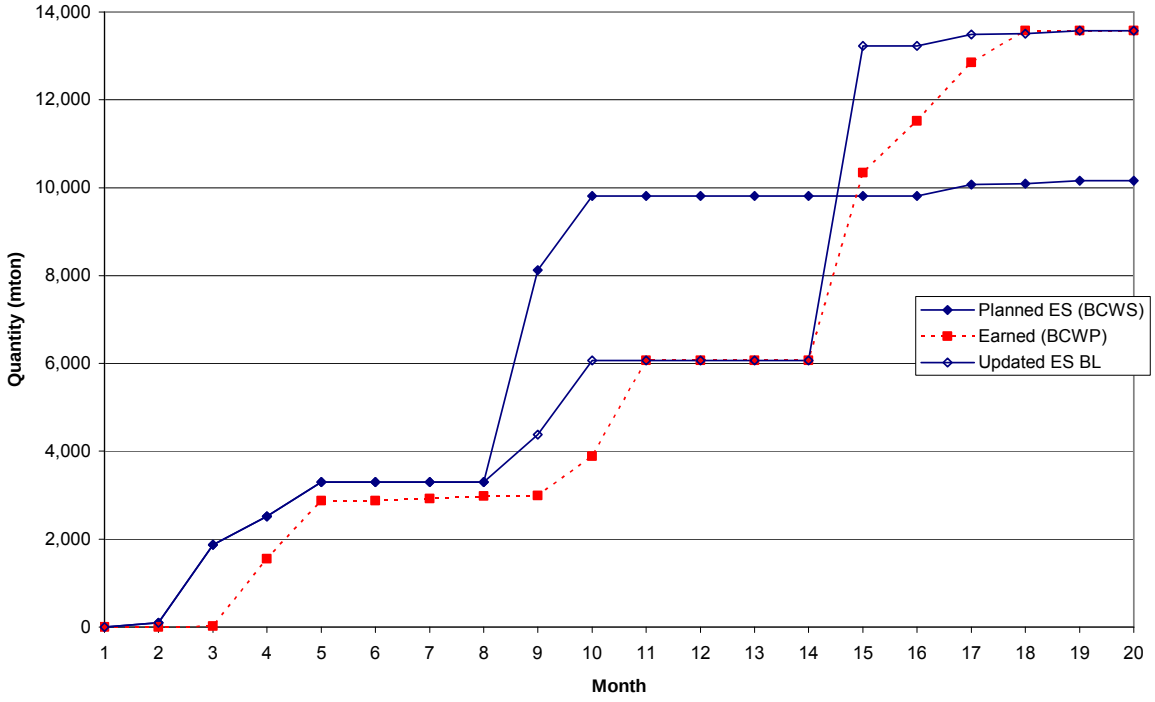
Tom's Creek Interchange
Borrow Excavation Commodity Curve



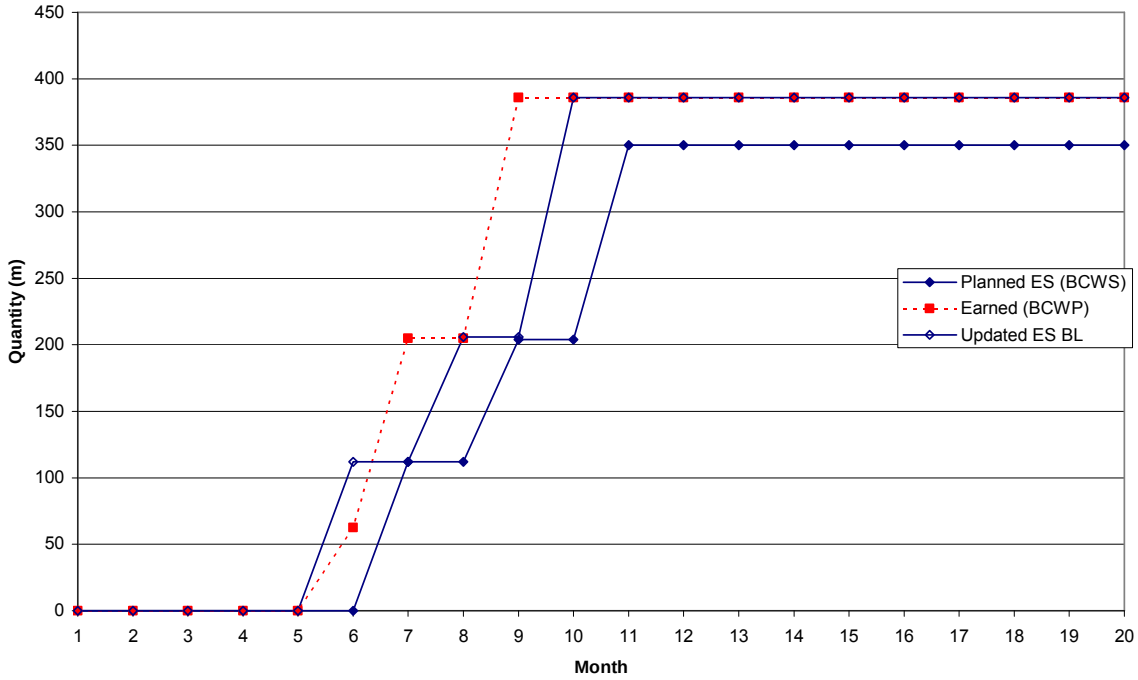
Tom's Creek Interchange
Aggragate Base 21B Commodity Curve

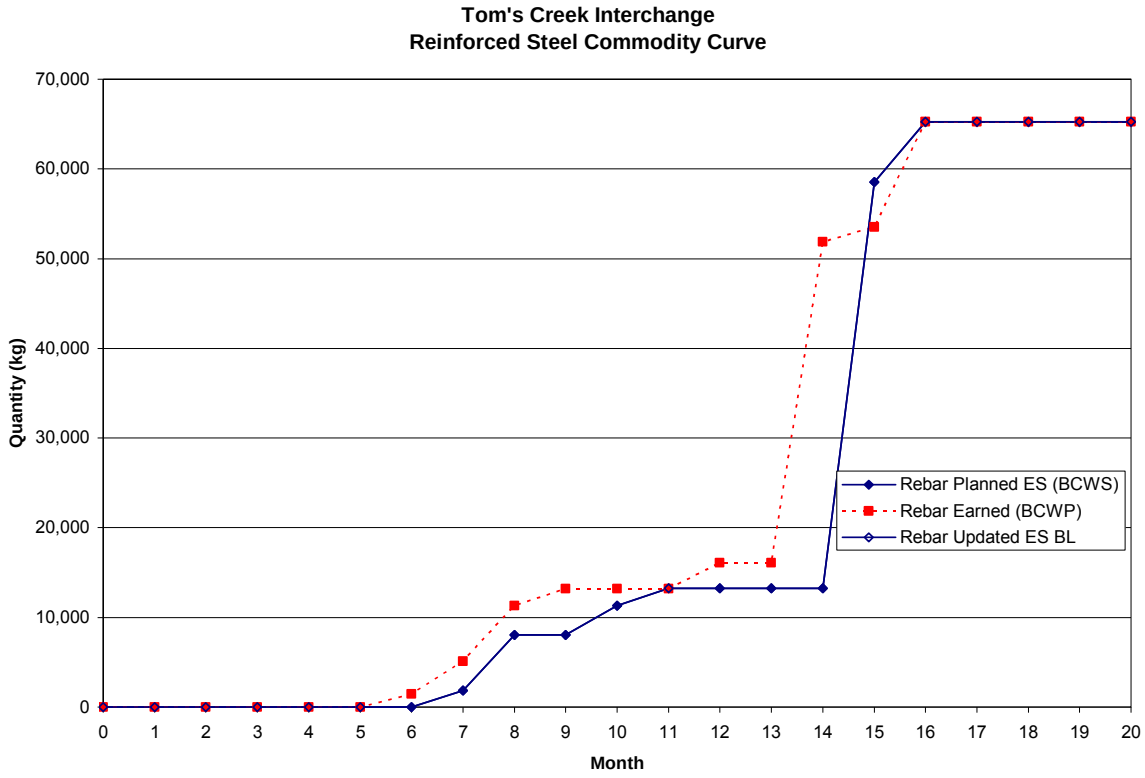


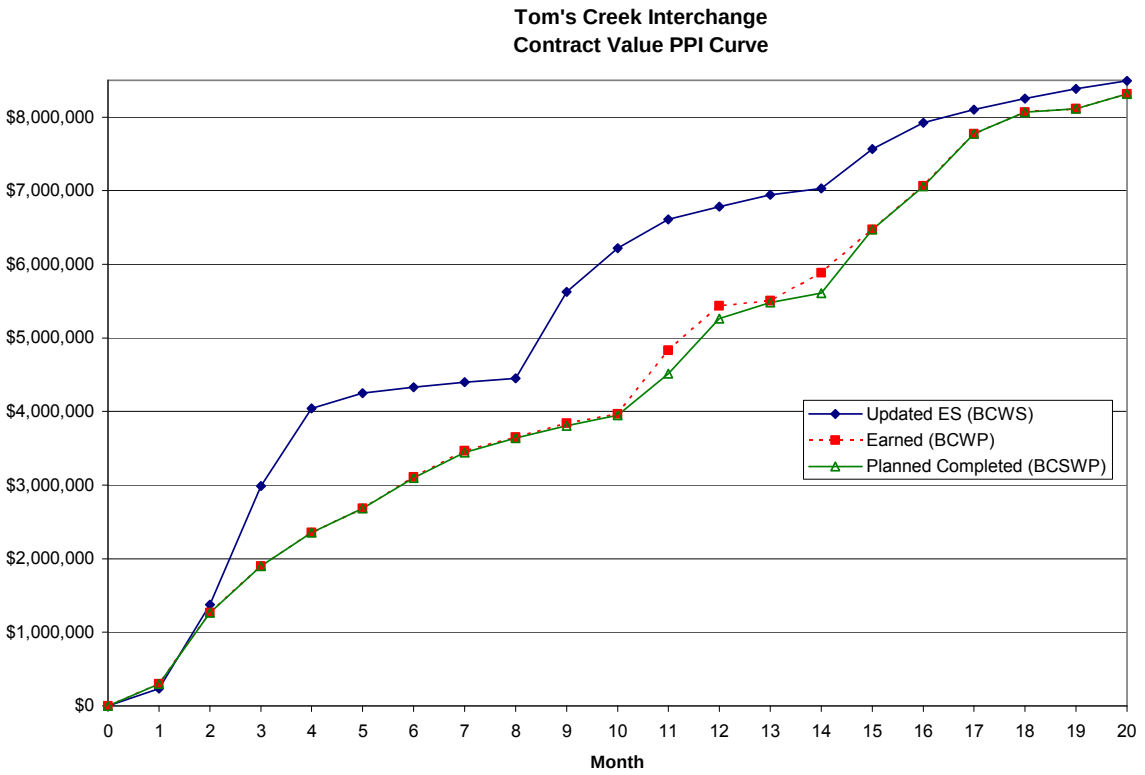
Tom's Creek Interchange
Asphalt Base Course 25 Commodity Curve

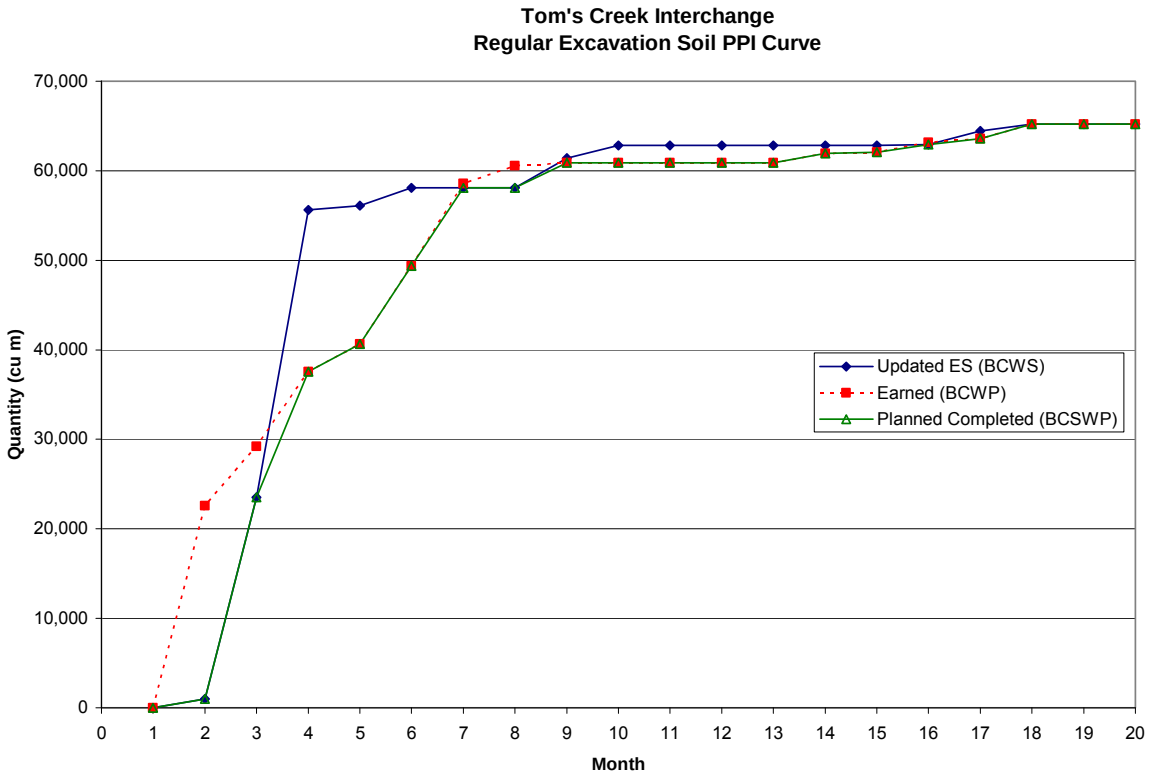


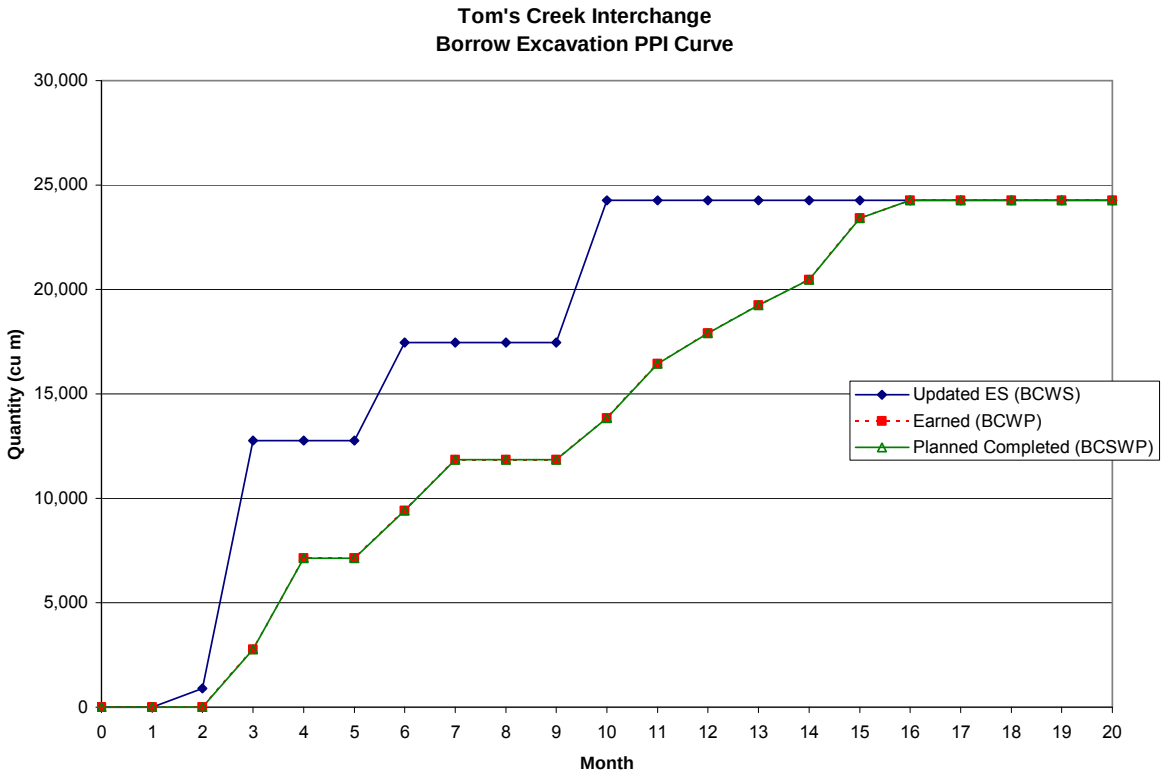
Tom's Creek Interchange
Steel Pile Commodity Curve

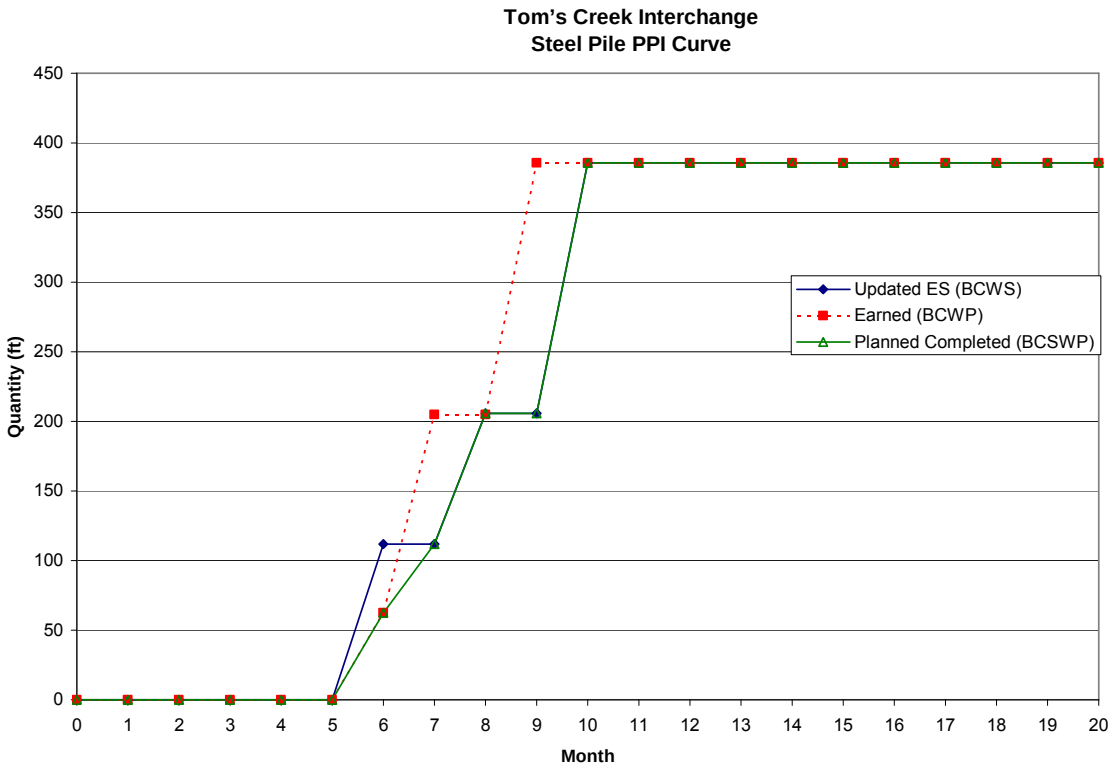


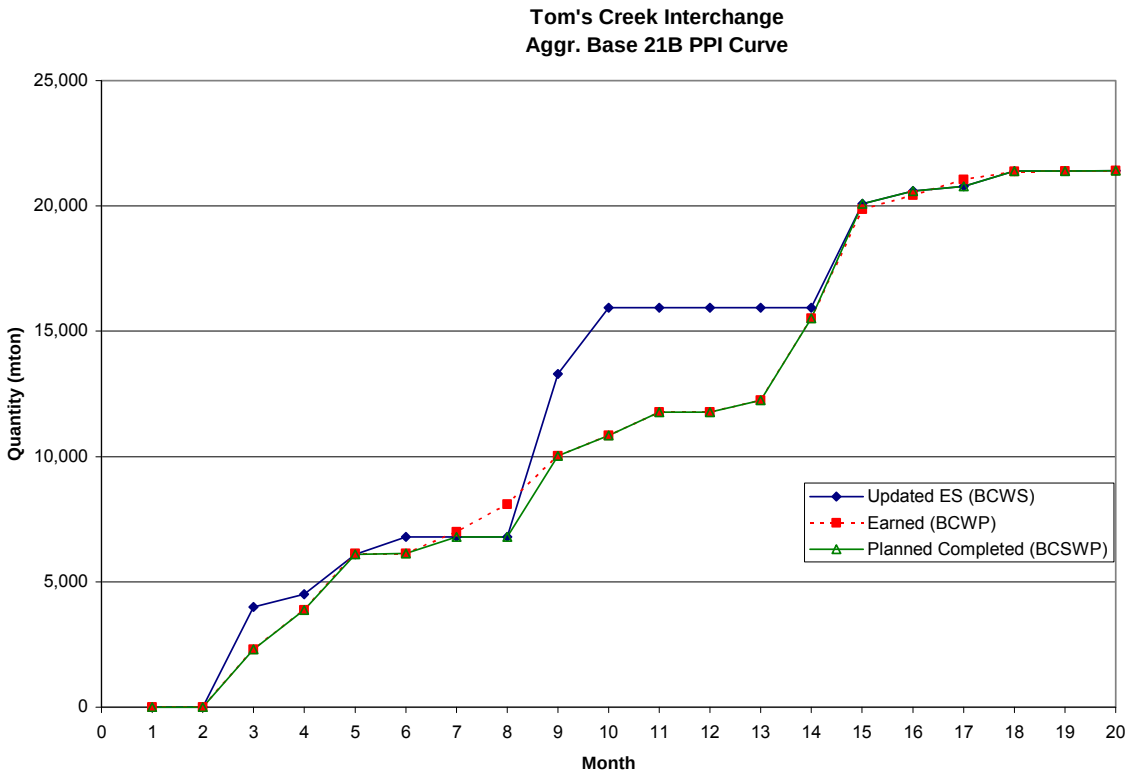

Tom's Creek Interchange
Reinforced Steel Commodity Curve
Quantity (kg)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Month
Rebar Planned ES (BCWS)
Rebar Earned (BCWP)
Rebar Updated ES BL

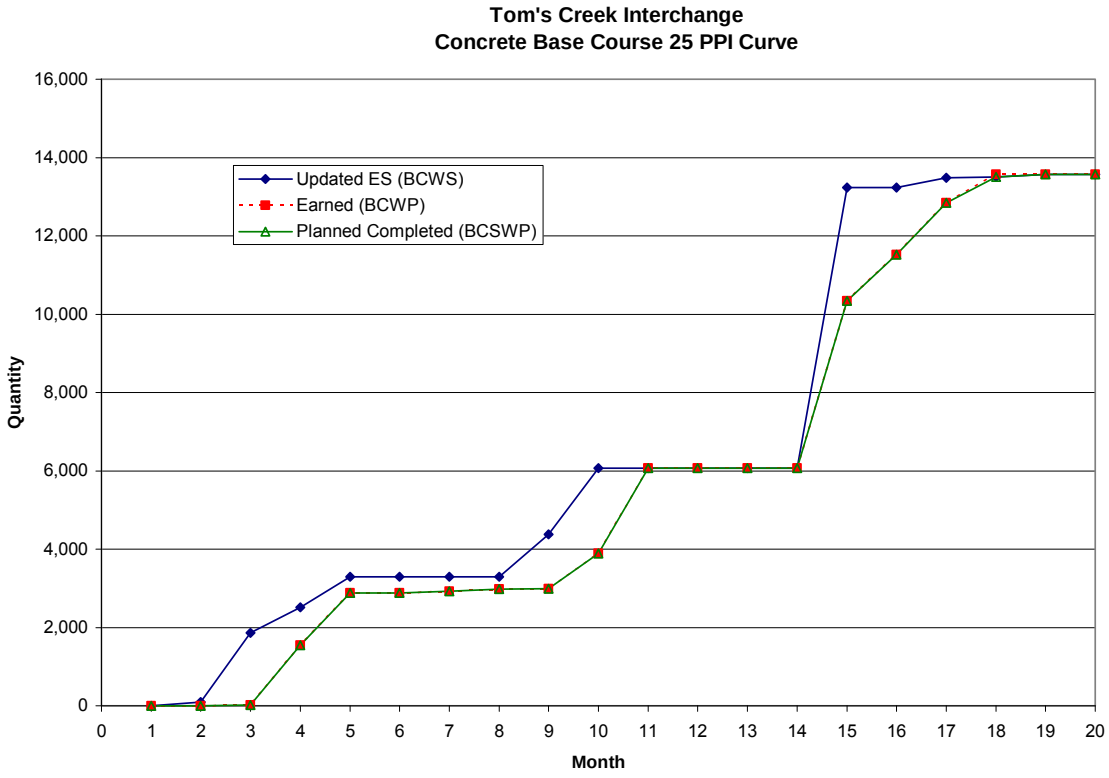

Tom's Creek Interchange
Contract Value PPI Curve
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Month
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)

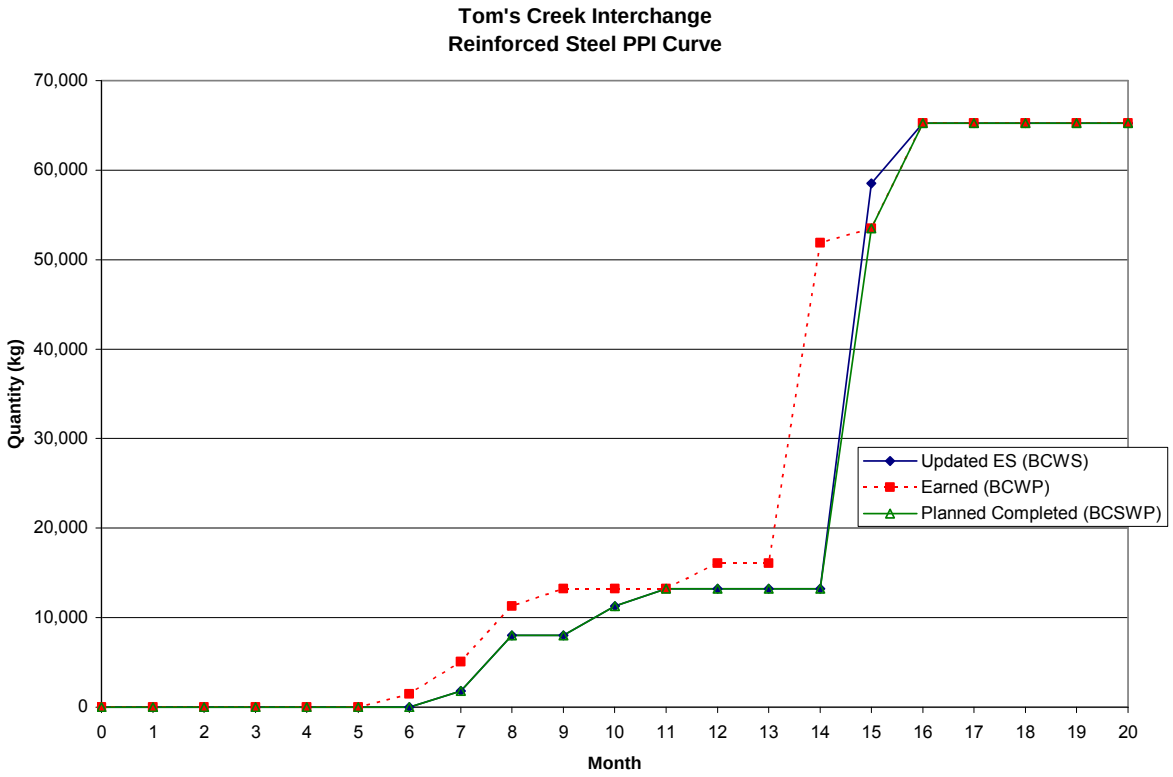

Tom's Creek Interchange
Regular Excavation Soil PPI Curve
Quantity (cu m)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Month
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)


Tom's Creek Interchange
Borrow Excavation PPI Curve
Quantity (cu m)
30,000
25,000
20,000
15,000
10,000
5,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Month
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)


Tom's Creek Interchange
Steel Pile PPI Curve
Quantity (ft)
Month
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)


Tom's Creek Interchange
Aggr. Base 21B PPI Curve
Quantity (mton)
Month
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)


Tom's Creek Interchange
Concrete Base Course 25 PPI Curve
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)
Quantity
Month
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


Tom's Creek Interchange
Reinforced Steel PPI Curve
Updated ES (BCWS)
Earned (BCWP)
Planned Completed (BCSWP)
Quantity (kg)
Month
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20