|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Task Name | Duration | Start | Finish | Predecessors |
| Land Measurements (1) | 8 days | Fri 1/14/22 | Tue 1/25/22 |  |
| Layout of measurement stakes (2) | 12 days | Wed 1/26/22 | Thu 2/10/22 | 1 |
| Analysis of surrounding environment (3) | 17 days | Wed 1/26/22 | Thu 2/17/22 | 1 |
| Building of foundation (4) | 22 days | Fri 2/11/22 | Mon 3/14/22 | 2 |
| Approval of construction papers (5) | 13 days | Fri 2/18/22 | Tue 3/8/22 | 3 |
| Layout of building framework (6) | 15 days | Fri 2/18/22 | Thu 3/10/22 | 3 |
| Gas line instalment (7) | 18 days | Fri 2/18/22 | Tue 3/15/22 | 3 |
| Electrical wiring (8) | 27 days | Wed 3/16/22 | Thu 4/21/22 | 2,7 |
| Interior plumbing (9) | 20 days | Wed 3/9/22 | Tue 4/5/22 | 2,5 |
| Wall construction (10) | 25 days | Fri 4/22/22 | Thu 5/26/22 | 4,8 |
| Insulation (11) | 23 days | Wed 4/6/22 | Fri 5/6/22 | 6,9 |
| Drywall (12) | 20 days | Wed 4/6/22 | Tue 5/3/22 | 6,9 |
| Roofing (13) | 10 days | Fri 5/27/22 | Thu 6/9/22 | 10,11 |
| Restaurant construction (14) | 40 days | Wed 3/16/22 | Tue 5/10/22 | 7 |
| Swimming pool (15) | 20 days | Fri 5/27/22 | Thu 6/23/22 | 7,10,11,12 |
| Fencing (16) | 10 days | Fri 5/27/22 | Thu 6/9/22 | 7,10,11,12 |
| Telephone lines (17) | 22 days | Fri 6/24/22 | Mon 7/25/22 | 13,15 |
| Completion of underground (18) | 25 days | Fri 6/24/22 | Thu 7/28/22 | 13,15 |
| Snack bar (19) | 20 days | Wed 5/11/22 | Tue 6/7/22 | 14 |
| Stream building (20) | 30 days | Wed 5/11/22 | Tue 6/21/22 | 14 |
| Outside lighting (21) | 12 days | Fri 6/10/22 | Mon 6/27/22 | 16,19 |
| Parking lots (22) | 5 days | Tue 7/26/22 | Mon 8/1/22 | 16,17,19 |
| Drainage construction (23) | 10 days | Tue 7/26/22 | Mon 8/8/22 | 16,17,19,20 |
| Safety inspection (24) | 15 days | Tue 8/9/22 | Mon 8/29/22 | 21,23 |
| Landscaping (25) | 24 days | Tue 8/2/22 | Fri 9/2/22 | 18,22 |
| Final permits/releases (26) | 15 days | Mon 9/5/22 | Fri 9/23/22 | 24,25 |

**A1: Tabular Schedule, Target Start and Completion Dates**

Note: Estimated duration was calculated using the (a+4m+b)/6 calculation, with the results of those calculations shown in the duration column for each task.

Critical Activities (Highlighted in red): A1 Land Measurement, C3 Analysis of surrounding environment, G7 Gas line Instalment, H8 Electrical Wiring, J10 Wall Construction, O15 Swimming Pool, Q17 Telephone Lines, V22 Parking Lots, Y25 Landscaping, Z26 Final Permits/Releases.

Gantt chart found in appendix under Chart 1.

**A2: Optimized Schedule**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Task Name | Duration | Start | Finish | Predecessors | Resource Names |
| Land Measurements | 8 days | Fri 1/14/22 | Tue 1/25/22 |  | Labor 1[300%] |
| Layout of measurement stakes | 12 days | Wed 1/26/22 | Thu 2/10/22 | 1 | Labor 1[300%] |
| Analysis of surrounding environment | 17 days | Wed 1/26/22 | Thu 2/17/22 | 1 | Labor 1[300%] |
| Building of foundation | 22 days | Fri 2/11/22 | Mon 3/14/22 | 2 | Labor 1[300%] |
| Approval of construction papers | 13 days | Fri 2/18/22 | Tue 3/8/22 | 3 | Labor 1[300%] |
| Layout of building framework | 15 days | Fri 2/18/22 | Thu 3/10/22 | 3 | Labor 1[300%] |
| Gas line Instalment | 18 days | Fri 2/18/22 | Tue 3/15/22 | 3 | Labor 1[300%] |
| Electrical Wiring | 27 days | Wed 3/16/22 | Thu 4/21/22 | 2,7 | Labor 1[300%] |
| Interior Plumbing | 20 days | Wed 3/9/22 | Tue 4/5/22 | 2,5 | Labor 1[300%] |
| Wall Construction | 25 days | Fri 4/22/22 | Thu 5/26/22 | 4,8 | Labor 1[300%] |
| Insulation | 23 days | Wed 4/6/22 | Fri 5/6/22 | 6,9 | Labor 1[300%] |
| Drywall | 20 days | Wed 4/6/22 | Tue 5/3/22 | 6,9 | Labor 1[300%] |
| Roofing | 10 days | Fri 5/27/22 | Thu 6/9/22 | 10,11 | Labor 1[300%] |
| Restaurant Construction | 40 days | Wed 3/16/22 | Tue 5/10/22 | 7 | Labor 1[300%] |
| Swimming Pool | 20 days | Fri 5/27/22 | Thu 6/23/22 | 7,10,11,12 | Labor 1[300%] |
| Fencing | 10 days | Wed 6/8/22 | Tue 6/21/22 | 7,10,11,12 | Labor 1[300%] |
| Telephone Lines | 22 days | Fri 6/24/22 | Mon 7/25/22 | 13,15 | Labor 1[300%] |
| Completion Of Underground | 25 days | Fri 6/24/22 | Thu 7/28/22 | 13,15 | Labor 1[300%] |
| Snack Bar | 20 days | Wed 5/11/22 | Tue 6/7/22 | 14 | Labor 1[300%] |
| Stream Building | 30 days | Wed 5/11/22 | Tue 6/21/22 | 14 | Labor 1[300%] |
| Outside Lighting | 12 days | Wed 6/22/22 | Thu 7/7/22 | 16,19 | Labor 1[300%] |
| Parking Lots | 5 days | Tue 7/26/22 | Mon 8/1/22 | 16,17,19 | Labor 1[300%] |
| Drainage Construction | 10 days | Tue 7/26/22 | Mon 8/8/22 | 17,19,20,16 | Labor 1[300%] |
| Safety Inspection | 15 days | Tue 8/9/22 | Mon 8/29/22 | 21,23 | Labor 1[300%] |
| Landscaping | 24 days | Tue 8/2/22 | Fri 9/2/22 | 18,22 | Labor 1[300%] |
| Final Permits/Releases | 15 days | Mon 9/5/22 | Fri 9/23/22 | 24,25 | Labor 1[300%] |

Analysis: Peak demand of resources was found to be 1,500% (15 people) based on the resource graph in Microsoft Project. Maximum availability was then lowered, resources were leveled, and the completion date was compared with the original completion date. This was done until the completion date changed. An optimized schedule was found at 1,200% (using 12 people) and the entire project was leveled, leaving the critical path the same, but shifting the start and completion times of certain tasks

Optimizing found a more efficient schedule, lowering the peak number of people needed for the project from 15 to 12 based on the task overlap found in the original schedule. This helps reduce overall costs because each person is to be paid $150 per day.

The optimization found that 12 people could be used and moved the Fencing task back from its original start date of 5/27/2022 to 6/8/2022. It also moved Outside Lighting back from 6/10/2022 to 6/22/2022.

The moving of these tasks decreased the overall amount of task overlap as compared to the unoptimized schedule, which at its height was 5 tasks, allowing for resources to be used more efficiently and without over allocating resources. The project still maintains a completion date that is before the mid-October deadline.

A new Gantt chart can be found in the appendix under chart 2.

**Part B:**

To figure out when we are 85, 90, and 95 percent sure that the project will be completed the following analysis was completed.

First, the critical path was determined to be A1, C3, G7, H8, J10, O15, Q17, V22, Y25, and Z26. From there the expected duration was calculated for each activity in the critical path using (a+4m+b)/6. Those expected times were then summed, coming out to 181 days. The variance for each activity was then calculated using ((b-a)/6)^2. The variances were summed, and the square root of that sum was found, equaling 9.921917.

In excel the =Norm.Inv function was used for 0.95, 0.90, 0.85. Those equations look like the following.

=Norm.Inv(0.95,181,9.921917)  
=Norm.Inv(0.90,181,9.921917)  
=Norm.Inv(0.85,181,9.921917)

Those equations calculated 197.320 for 95 percent, 193.75 for 90 percent, and 191.283 for 85 percent. The numbers are then rounded up to nearest who number since we are using a single day as the smallest unit. That gives us 198 days for 95 percent, 194 days for 90 percent, and 192 for 85 percent.

Given a start date of 1/14/2022 and using 5-day work week, the following dates were found at the various percentages:

95 Percent: 10/18/2022  
90 Percent: 10/12/2022  
85 Percent: 10/10/2022

These figures convey that there is a 95 percent chance that the project will be completed in 198 days (10/19/2022), a 90 percent chance that the project will be completed in 194 days (10/12/2022), and an 85 percent chance that the project will be completed in 192 days (10/10/2022).

The project needs to be completed by October 15, 2022 or there will be a penalty.

