



transforming the way the world works



True 4D BIM: Location Based Management Systems

- 3D needs 2D therefore 5D needs 4D
- BIM for the GC/CM
- Use 5D and 4D integrated data to manage the workforce
- Four cases proving that 4D is needed at the workforce

BIM to Ponder

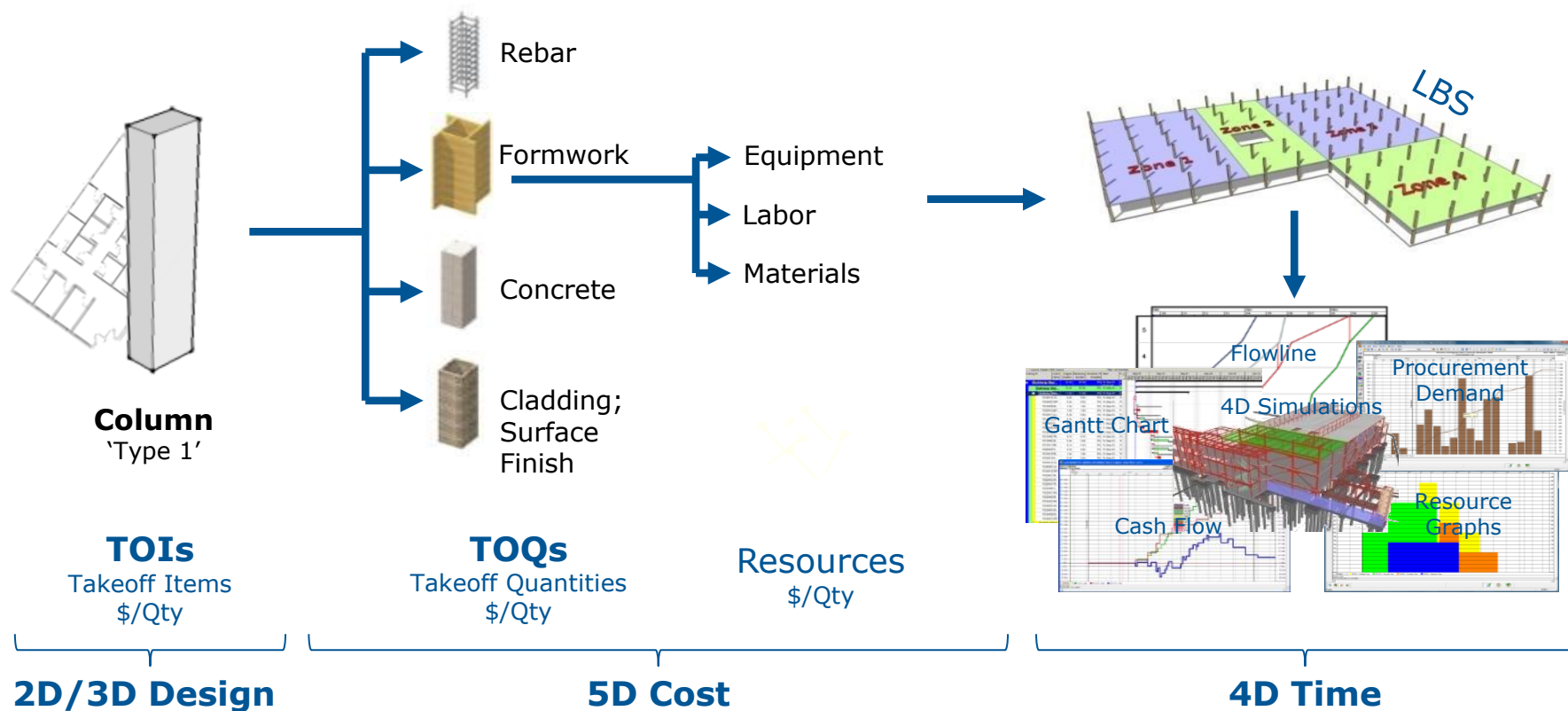
- Is estimating and scheduling without BIM 1D?
- Can you have 3D without 2D?
- In construction can silo'd workflows make the team successful?
- Does BIM exist for the GC/CM without 2D, 3D, 4D and 4D?
- And...



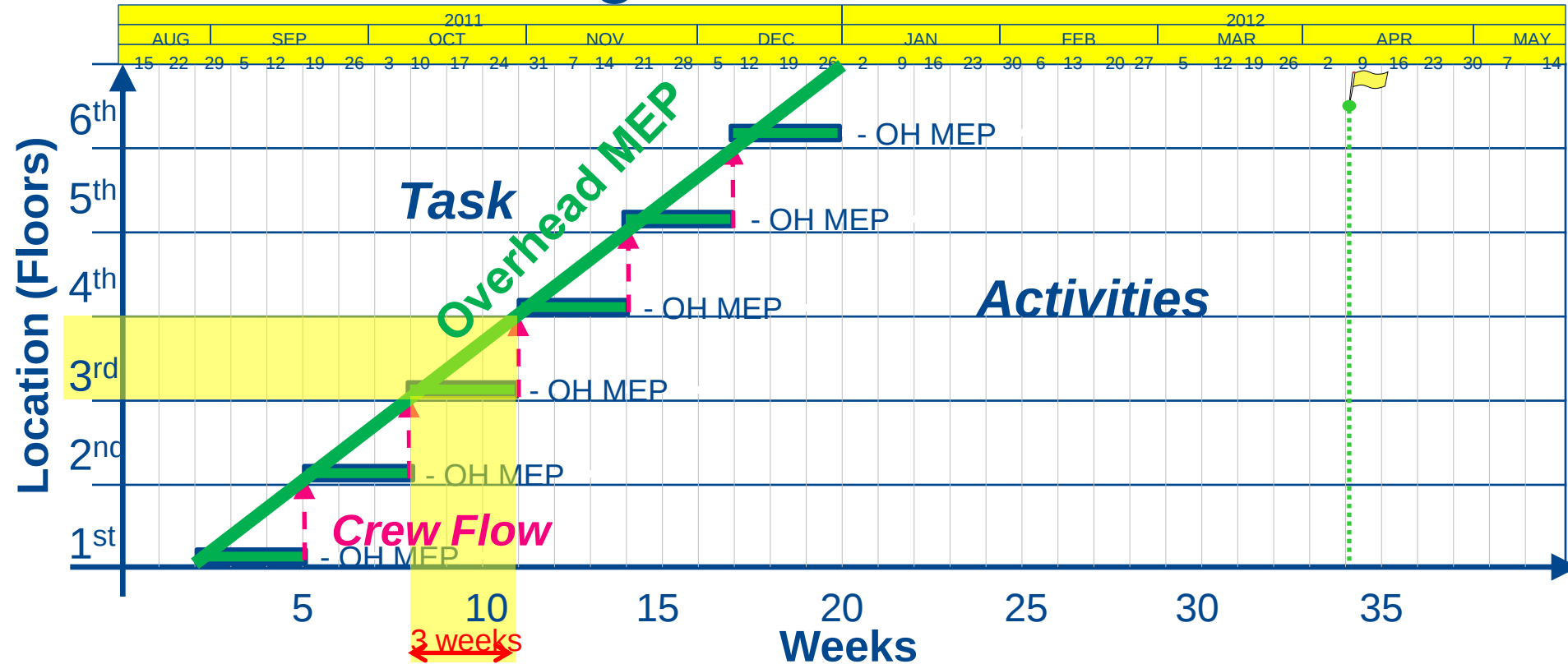
What is 5D without 4D?

- Non-integrated process
- Will not allow you to get 5D into the field
- 4D is the missing link between what matters to you construction manager and what matter to your project executive
- 4D is more then a simulation – it includes controlling your 5D
- 3 Cases:
 - QVMC how not using integrated 5D hurts the project team
 - KPOMC SMOB how using integrated 5D helps the project team
 - Camino Medical Centre integrated 5D project optimization

2D/3DBIM+5DCostPlanning+4DScheduling

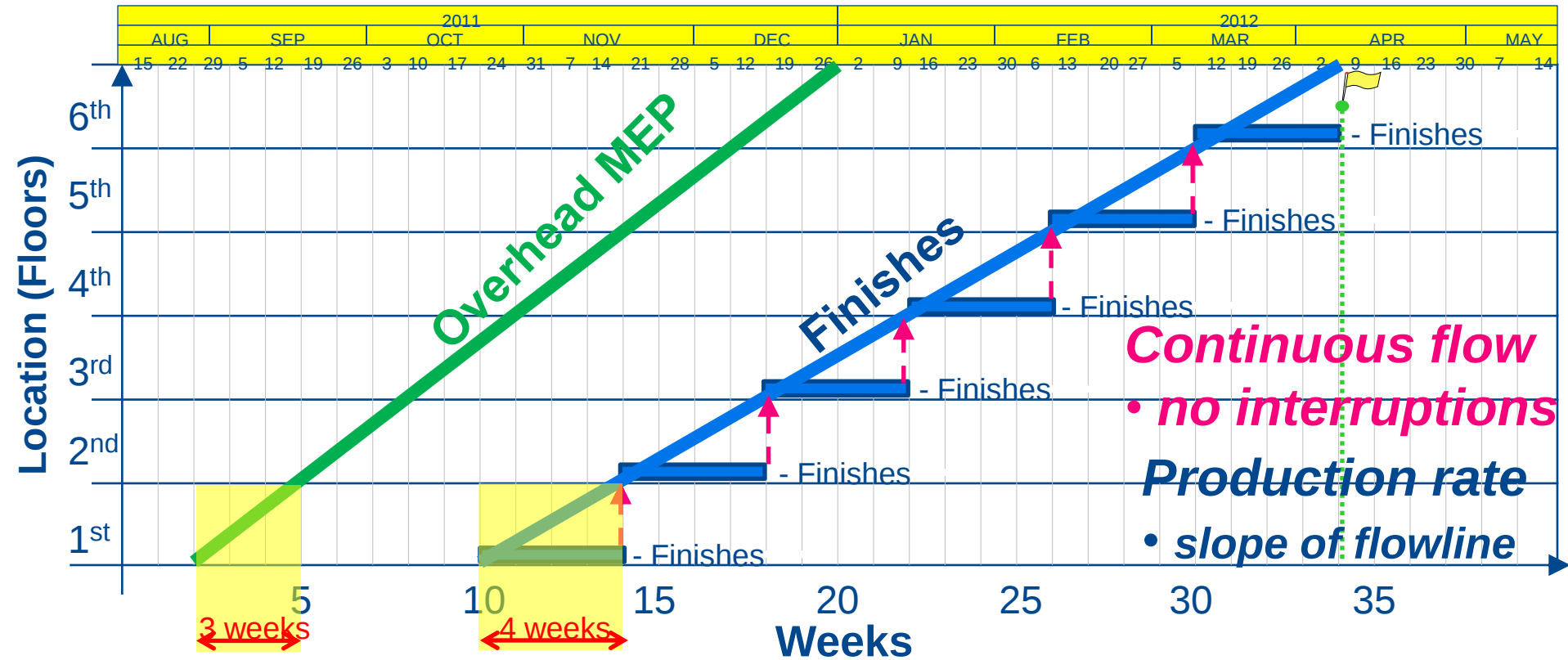


Flowline Diagram – Overhead MEP

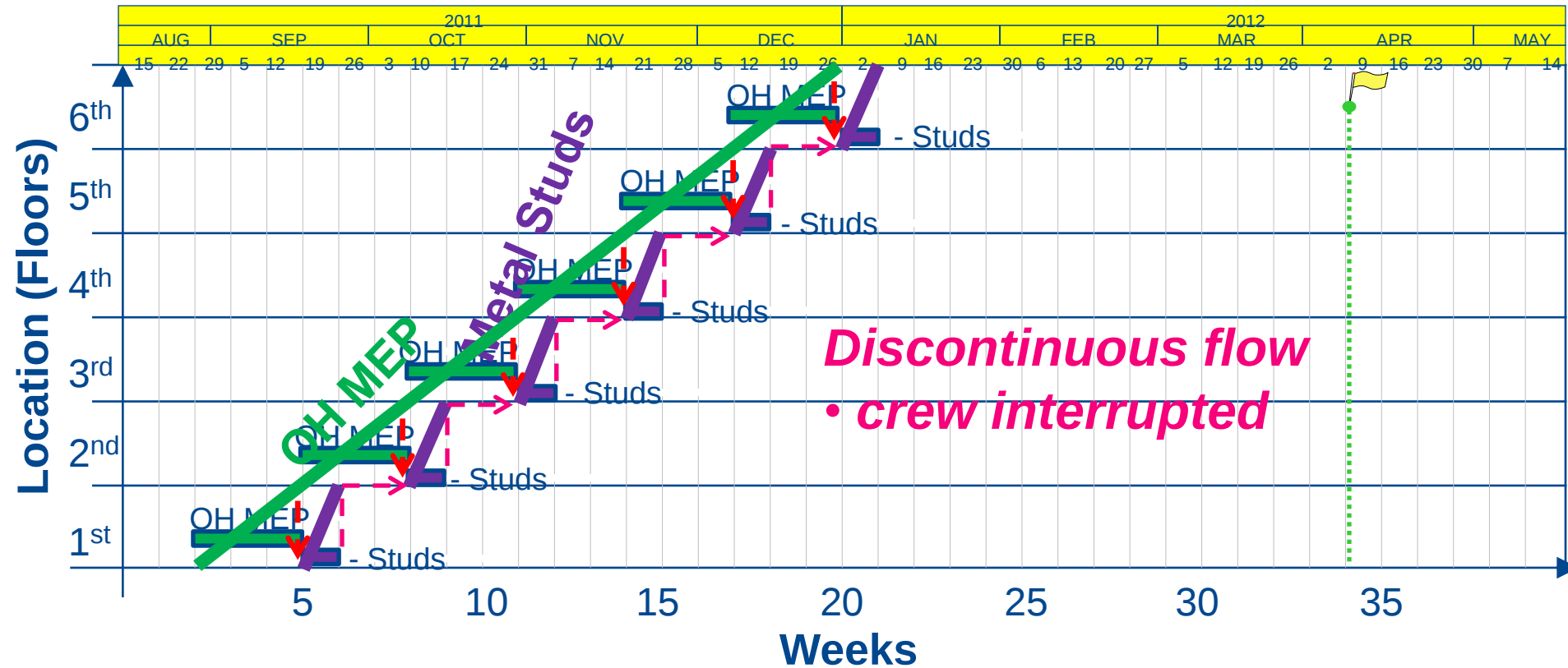


Flowline: graphical representation of movement of crews over time

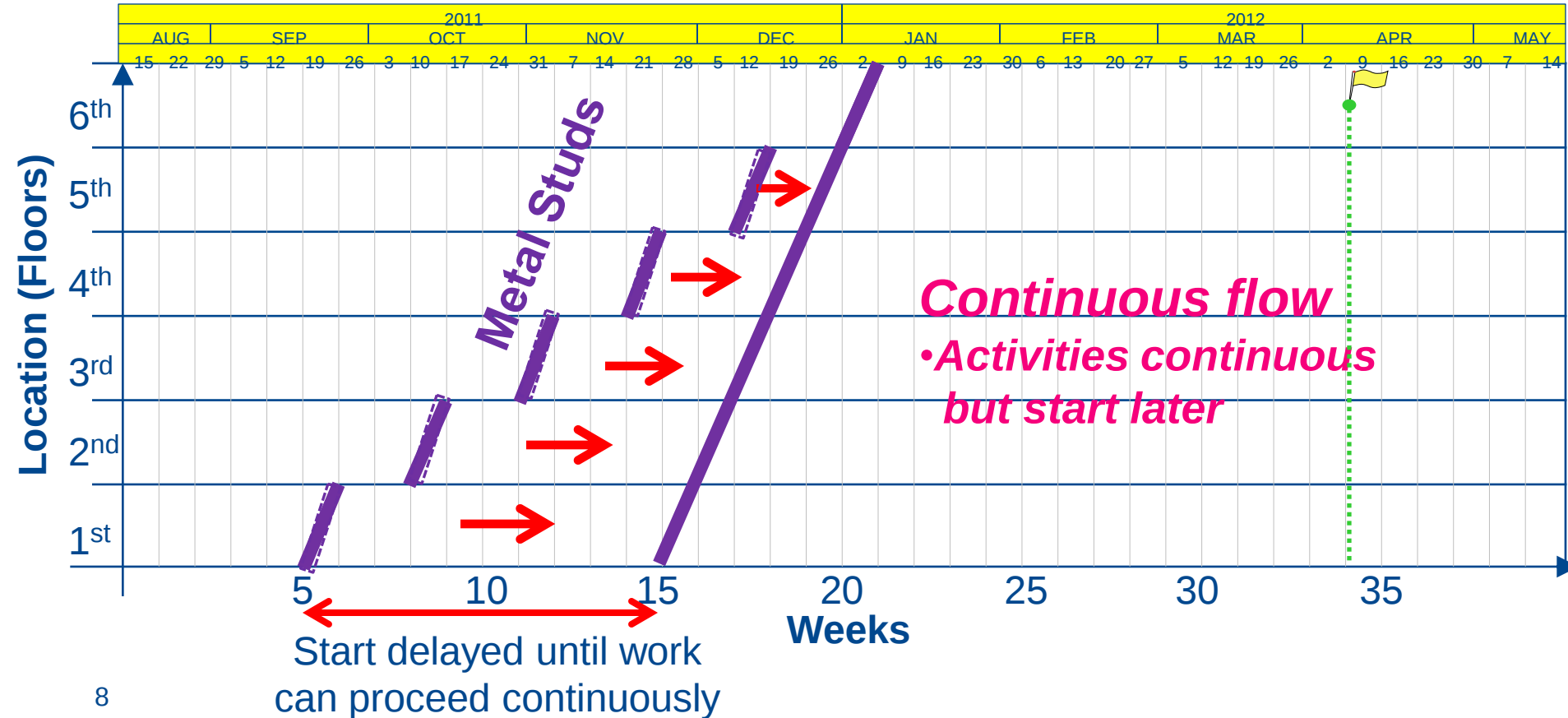
Flowline Diagram



Flowline Diagram



Flowline Diagram – Continuous Flow





Acute Care Facility in Napa, California
72,000 SF added to existing Medical Center
Includes six Smart Operating Rooms, 20 private intensive care rooms, clinical and pathology laboratories

QVMC HERMAN FAMILY PAVILION

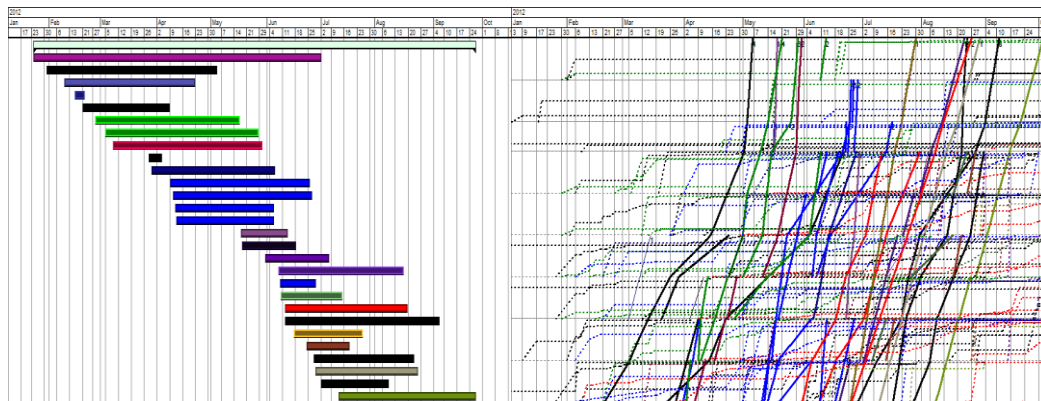
Case Study: ASAP Cost and Time Management

The Client:

- Wanted to understand Cost associated per their process
- 5D-4D LBMS used for Reporting only
- Schedule and cost was managed using ASAP approach

What we observed in recorded actuals data:

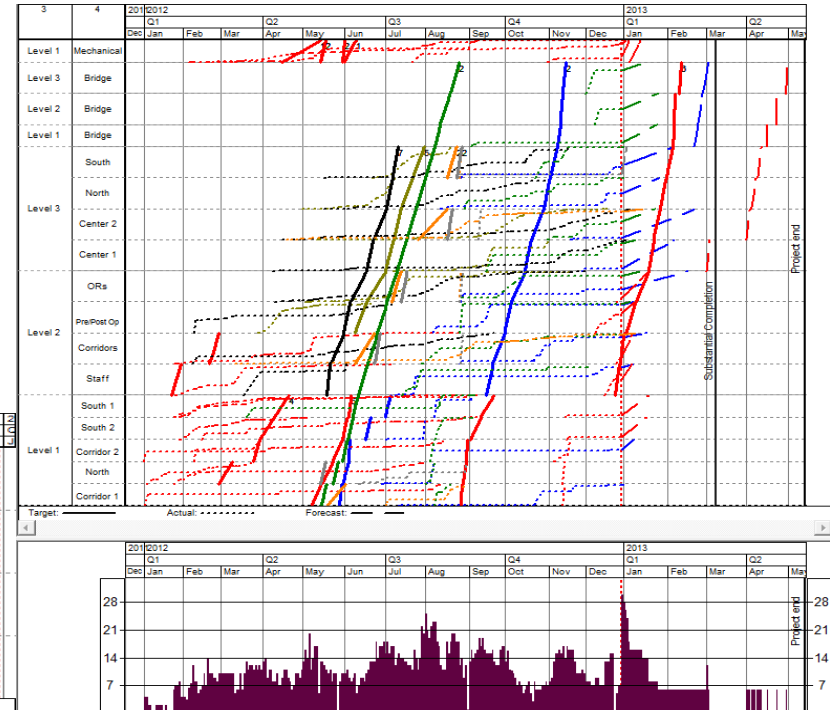
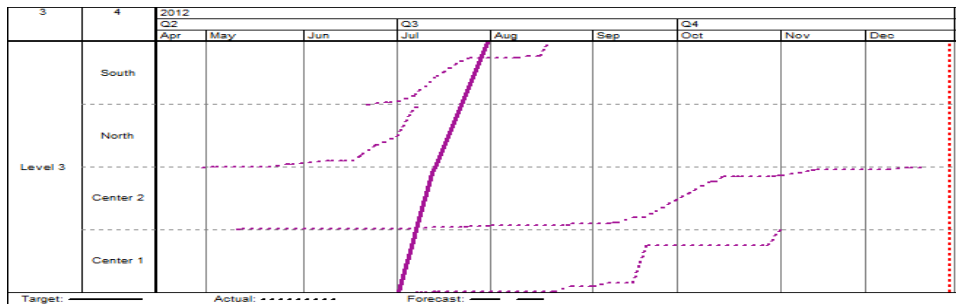
- (De)mobilizations
- Waiting Time
- “Blow-fly” effect
- “Flat-lining”
- Cascading delays



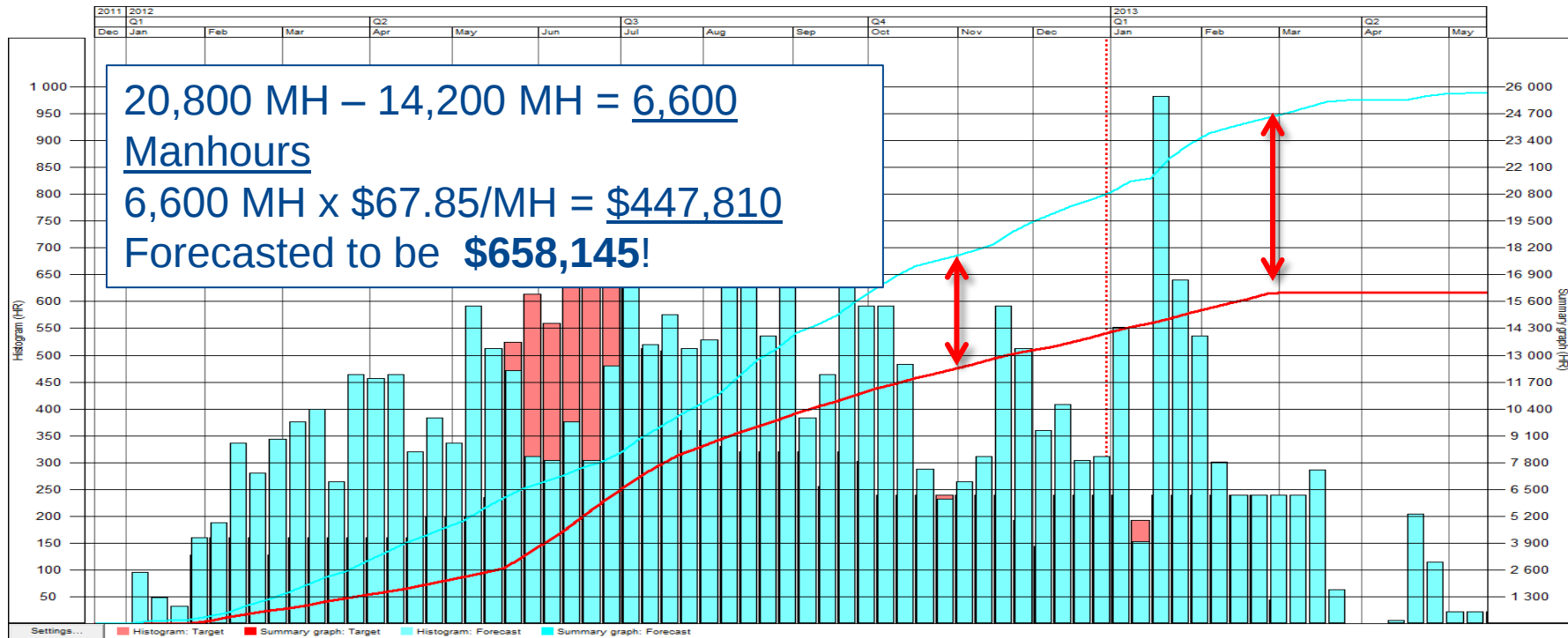
Actual Behaviors: Electrical Trade

Observed Patterns:

- Early Starts in most locations
- Slower than planned production
- Multiple locations active at the same time
- Working out of sequence
- Smaller than planned crew size



Actual Costs of Behavior: Electrical Trade



NB: Generic Cost data (Source: RS Means 2010) has been applied to preserve the indemnification of the General Contractor on this case project



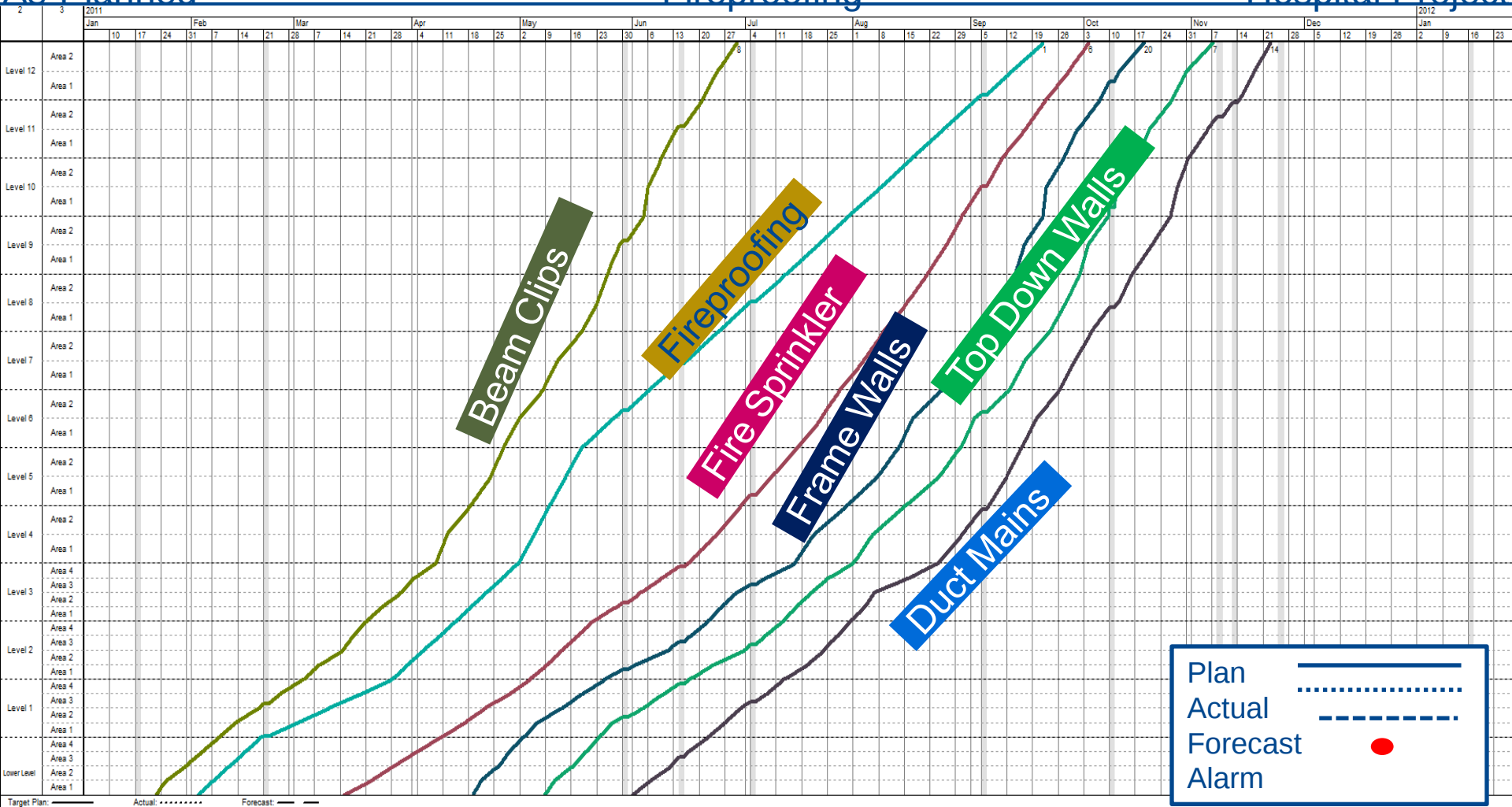
\$700 million hospital in Oakland, California
68,400 M2 replacement hospital on new Medical Center Campus
Includes 350 patient beds, 16 operating rooms and 2 hybrid ORs

KPOMC HOSPITAL TOWER

As-Planned

Fireproofing

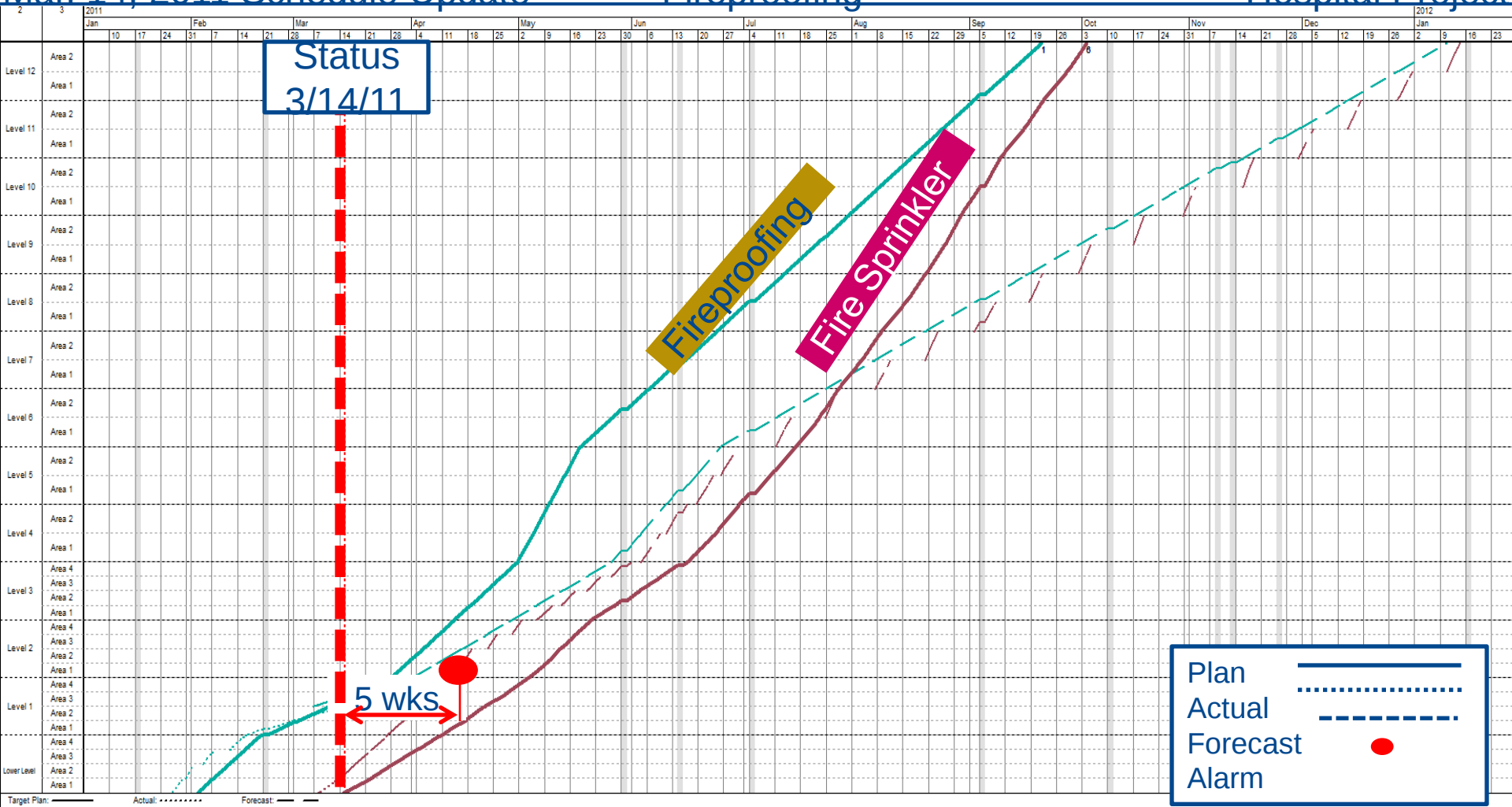
Hospital Project



Mar. 14, 2011 Schedule Update

Fireproofing

Hospital Project



3/14/11

TOWER + Podium (Interior Task Production)						
Name	Target/Estimated			Actual		
	Production rate units/day	units / day	Progress	Production rate units/day	units / day	Progress
BEAM CLIPS	10,356	SF	15%	13,563	SF	25%
FIRE PROOFING	2,000	SF	6%	1,764	SF	15%
FIRE SPRINKLER	436	LF	0%	541	LF	4%

Control Action: Deploy 3rd gun for pick up fireproofing work

Plan
Actual
Forecast
Alarm

Level	Area	4/11	4/18	5/4	5/9	6/23	6/30	7/20	7/28	8/4	8/15	8/30	9/6
4	2												
	1	4/7 3/9	4/11 0%	4/29	5/4	6/15	6/23	7/14	7/20	8/1	8/4	8/23	8/30
3	4	4/1 3/4	4/7 3/8	4/26	4/29	6/8	6/15	7/6	7/14	7/25	8/1	8/15	8/23
	3	3/29 2/28	4/1 3/3	4/21	4/26	6/2	6/8	6/29	7/6	7/19	7/25	8/5	8/15
	2	3/24 2/24	3/29 2/26	4/18	4/21	5/26	6/2	6/24	6/29	7/14	7/19	8/3	8/5
	1	3/21 2/23	3/24 2/24	4/13	4/18	5/20	5/26	6/21	6/24	7/12	7/14	7/29	8/3
2	4	3/16 2/19	3/21 2/22	4/8	4/13	5/17	5/20	6/16	6/21	7/6	7/12	7/26	7/29
	3	3/14 2/16	3/16 2/17	4/5	4/8	5/12	5/17	6/10	6/16	6/30	7/6	7/22	7/26
	2	3/7 2/15	3/14 2/16	3/31	4/5	5/9	5/12	6/1	6/10	6/22	6/30	7/19	7/22
		3/2	3/7	3/28	3/31	5/4	5/9	5/24	6/1	6/16	6/22	7/12	7/19
						5/4	5/18	5/24	6/8	6/16	7/7	7/12	

Legend

Work Complete

Work in progress

Suspended

Location Late

Work Started Late

Suspended and Late

Location Ready



Target Start

Target Finish

2/3	2/8	2/15	2/18	4/4	4/8	4/27	5/2	5/18	5/23	6/15	6/21
1/24	2/1	2/10	2/15								
1/18	2/3	2/10	2/15	3/28	4/4	4/25	4/27	5/16	5/18	6/10	6/15
1/24	1/28	2/7	2/10	3/21	3/28	4/20	4/25	5/10	5/16	6/6	6/10
1/14	1/26	1/29	2/1	3/12	0%						
1/21	1/24	2/2	2/7	3/14	3/21	4/18	4/20	5/6	5/10	5/31	6/6
1/13	1/22	1/26	1/28	3/7	3/11						

Beam Clips

Fireproofing

Fire
Sprinkler

Frame Walls

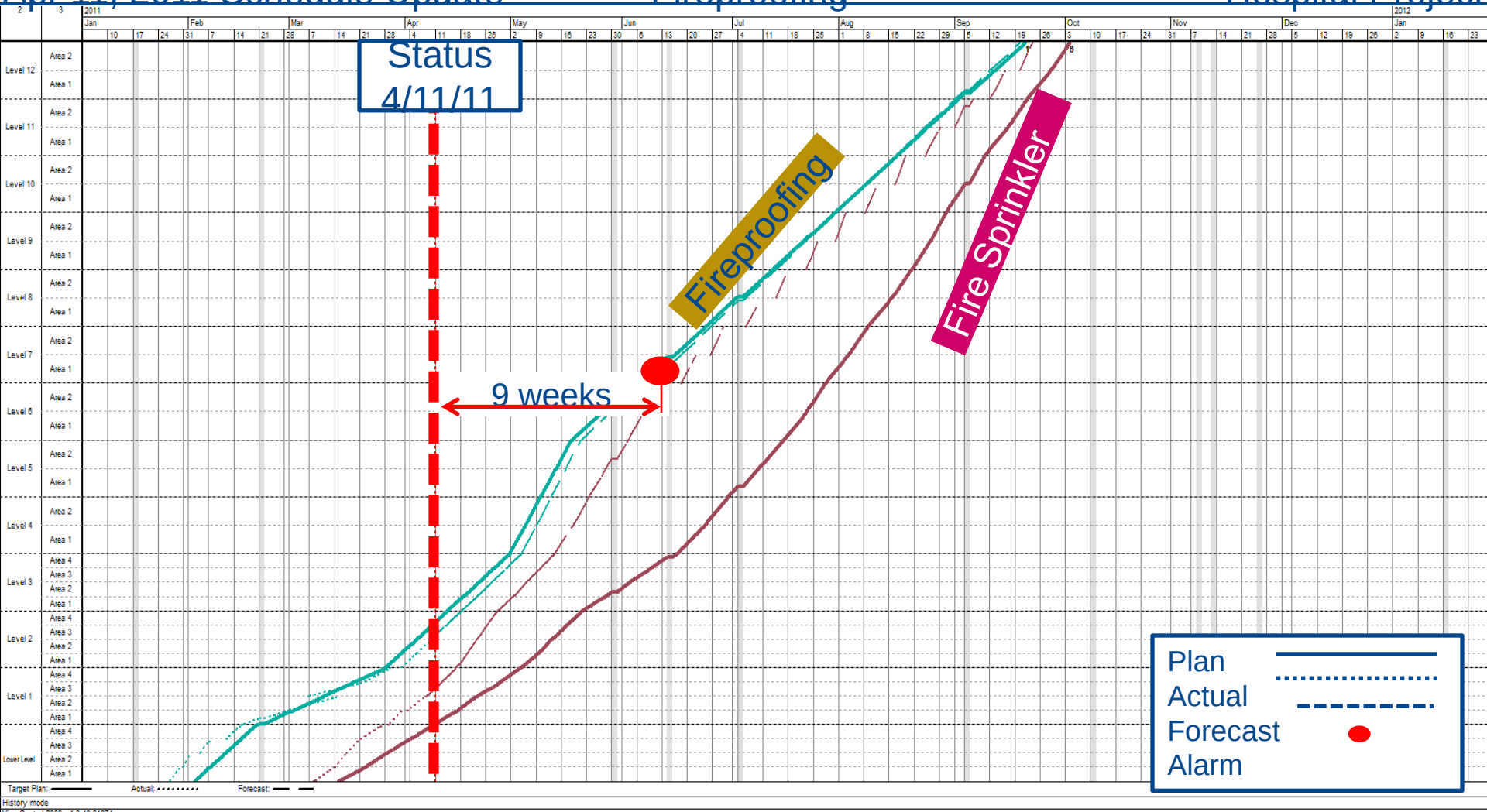
Top Down
Walls

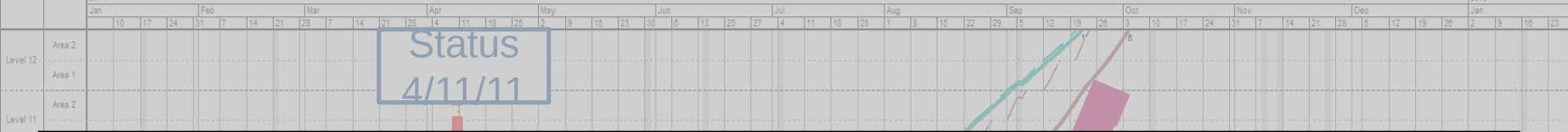
Duct Mains

Apr 11, 2011 Schedule Update

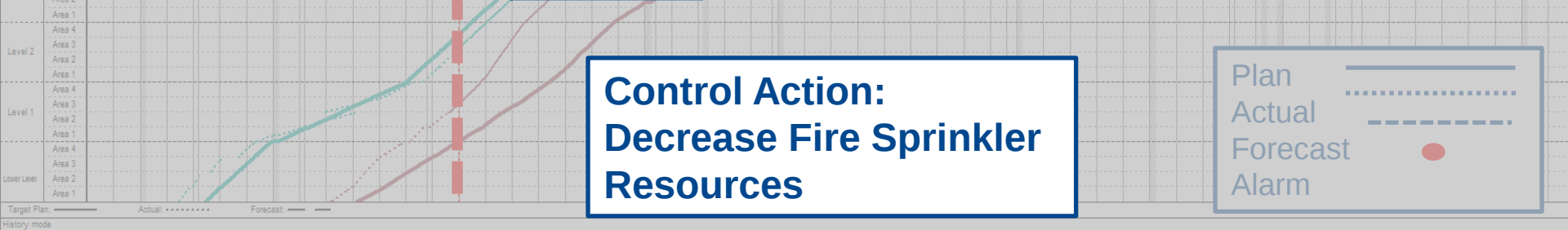
Fireproofing

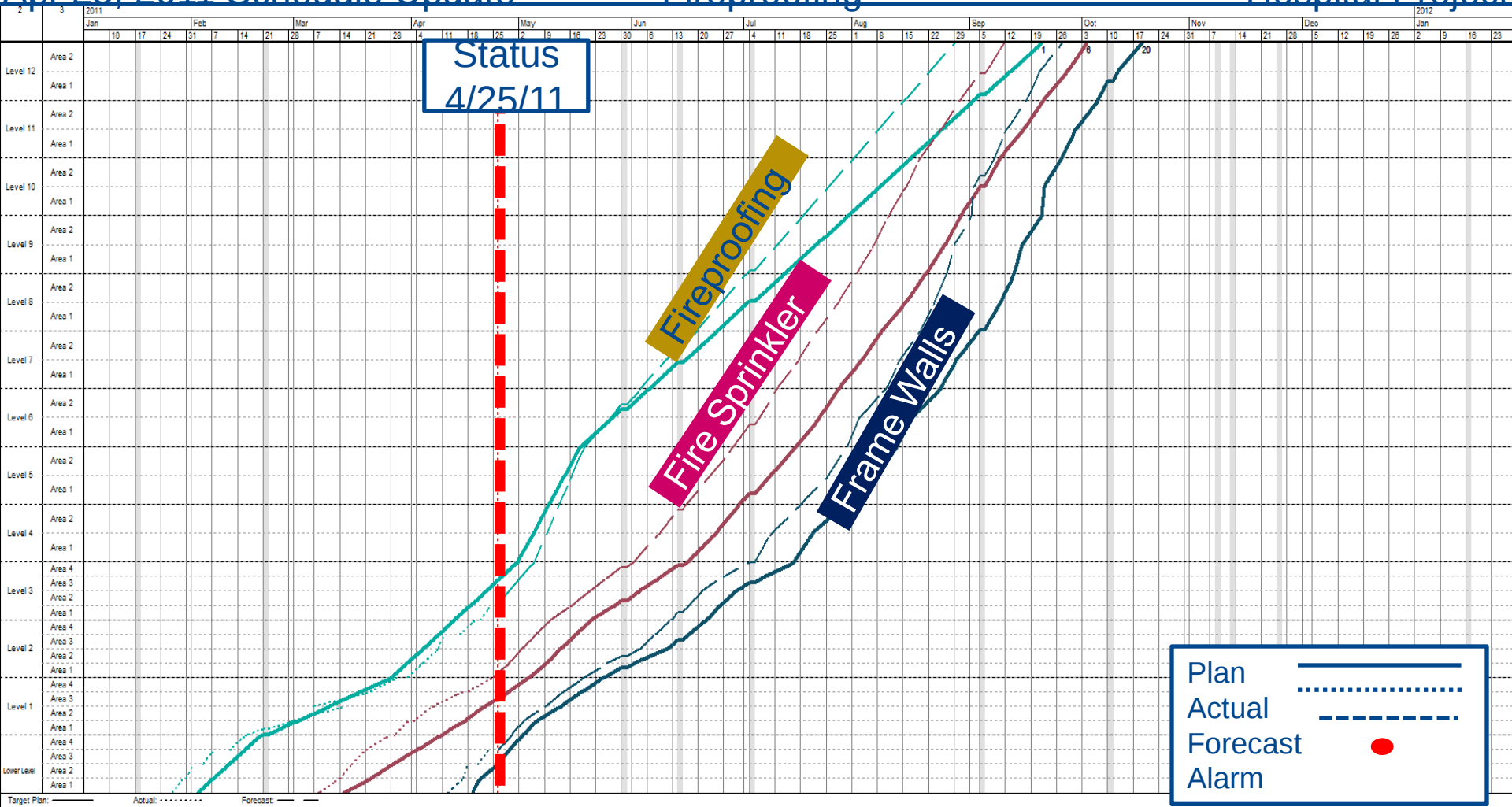
Hospital Project

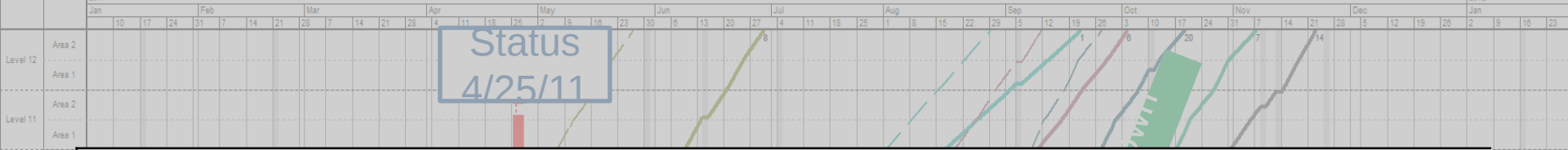




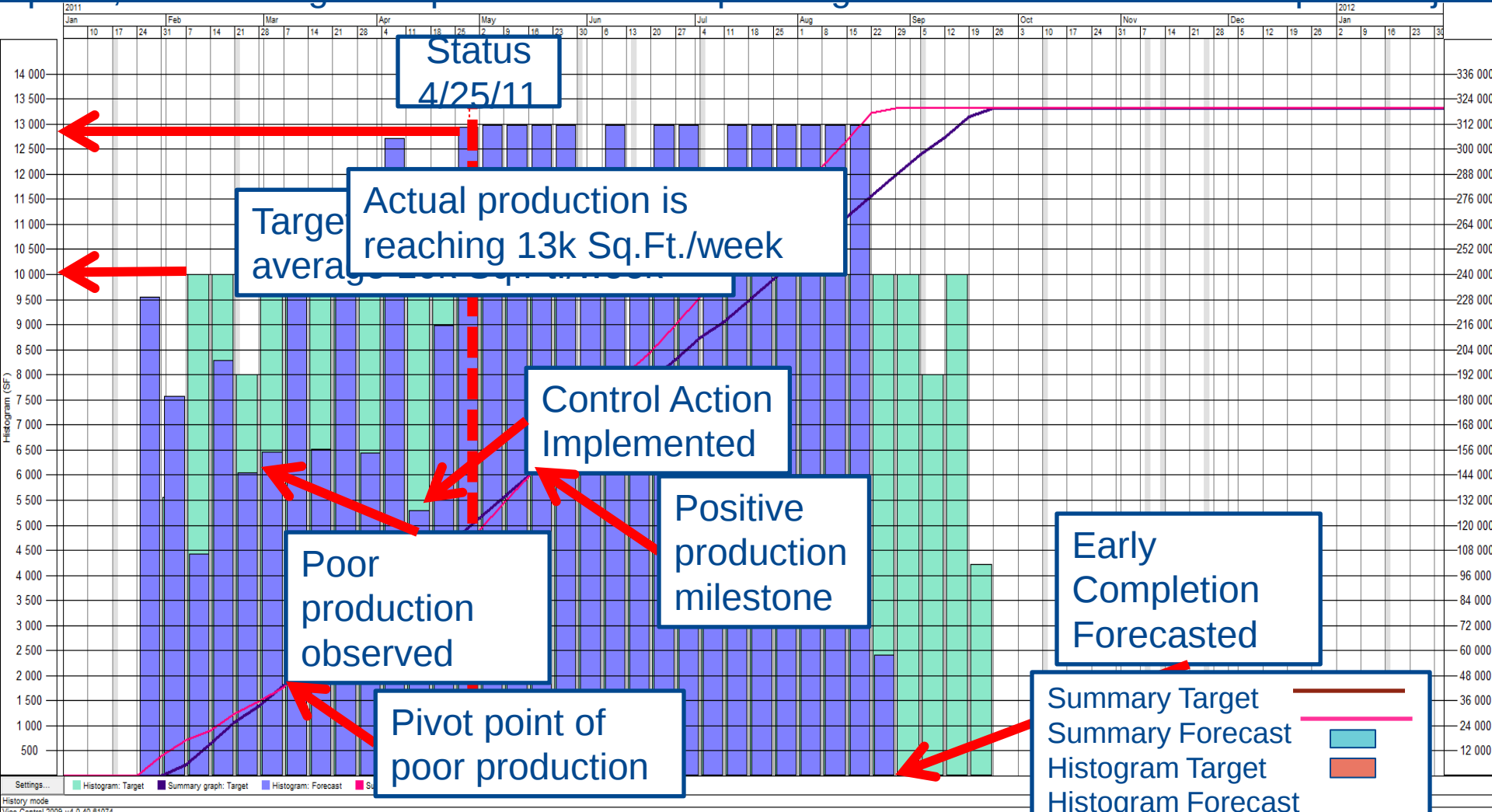
TOWER + Podium (Interior Task Production)						
Name	Target/Estimated			Actual		
	Production rate units/day	units / day	Progress	Production rate units/day	units / day	Progress
FIRE PROOFING	2,000	SF	30%	2,031	SF	29%
FIRE SPRINKLER	436	LF	14%	560	LF	19%

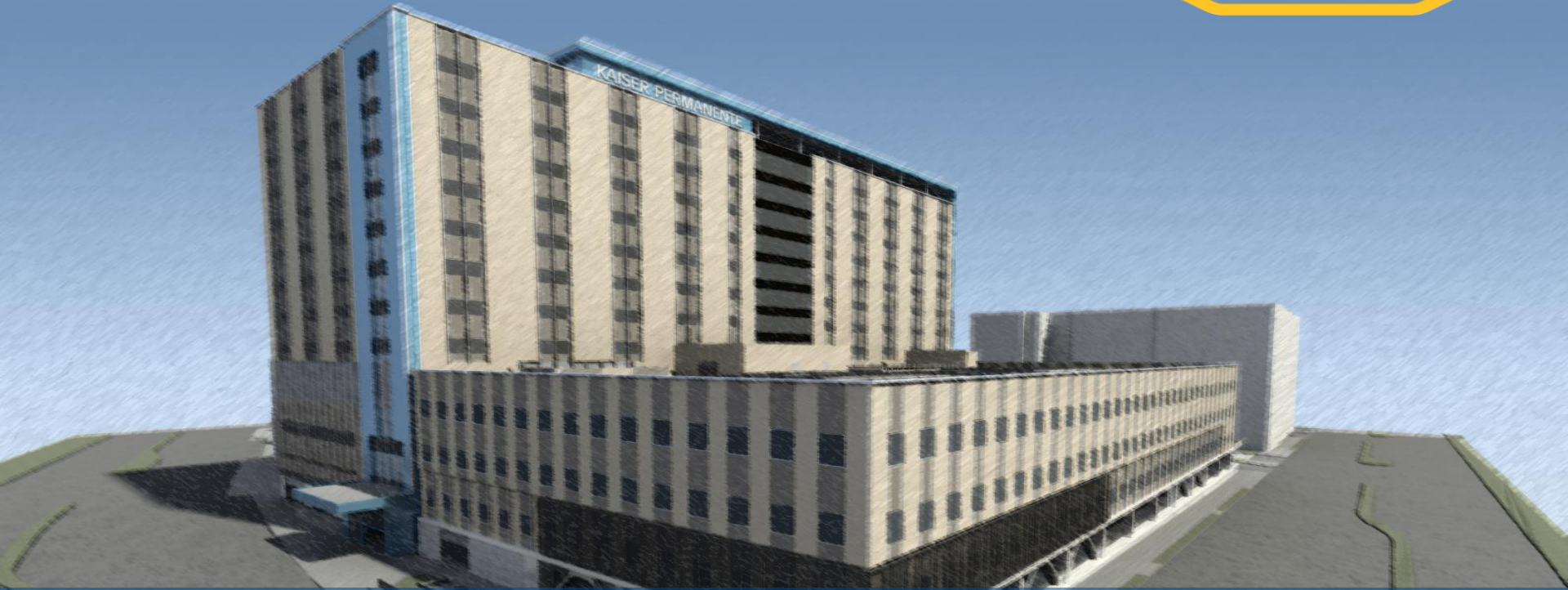






TOWER + Podium (Interior Task Production)						
Name	Target/Estimated			Actual		
	Production rate units/day	units / day	Progress	Production rate units/day	units / day	Progress
BEAM CLIPS	10,356	SF	60%	12,622	SF	81%
FIRE PROOFING	2,000	SF	36%	2,067	SF	33%
FIRE SPRINKLER	436	LF	21%	492	LF	26%
FRAME PRIORITY WALLS	2,939	SF	4%	3,021	LF	6%





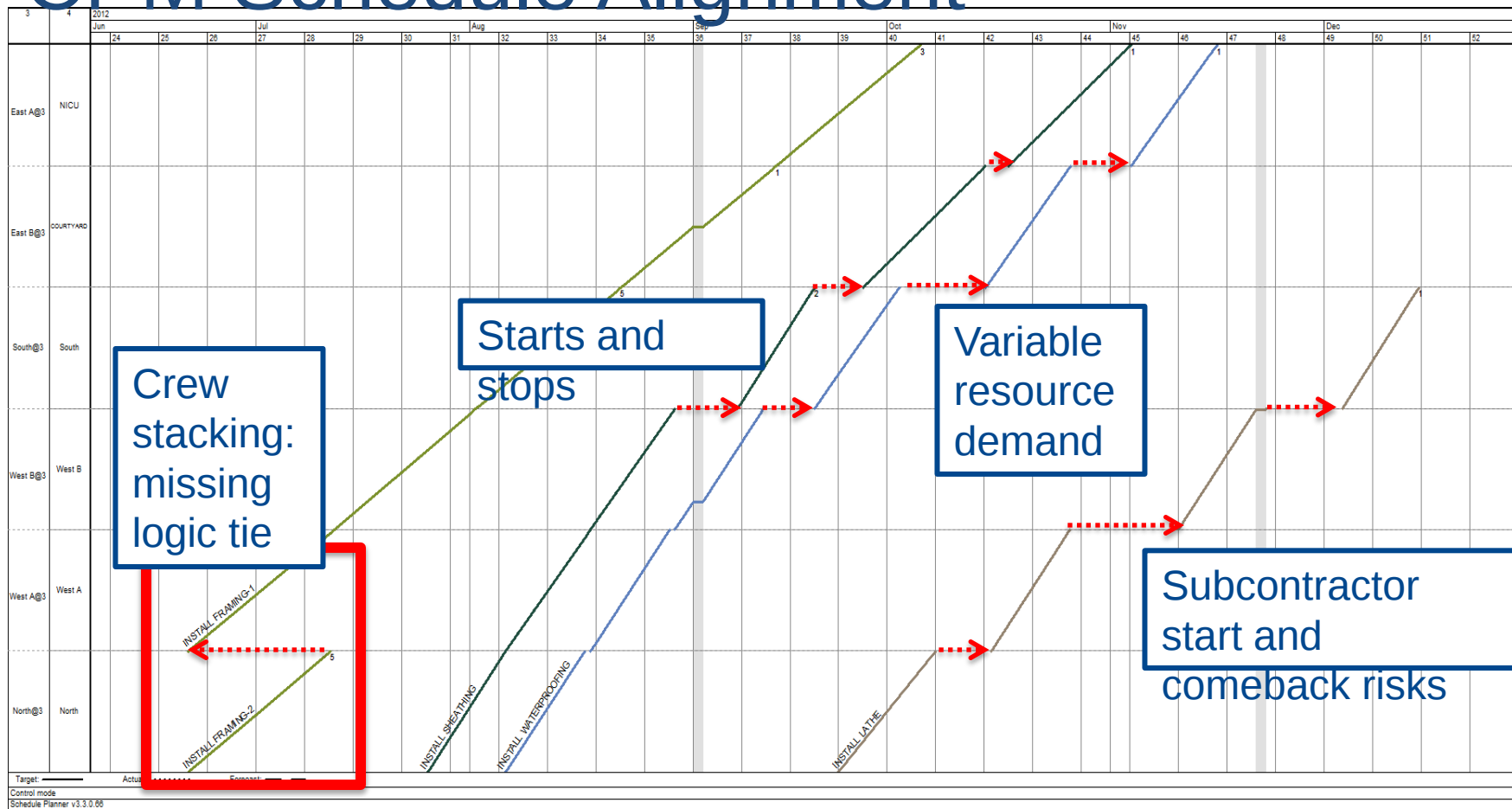
MOB in Oakland, CA

22,500 M2 ancillary support building on new Medical Center Campus

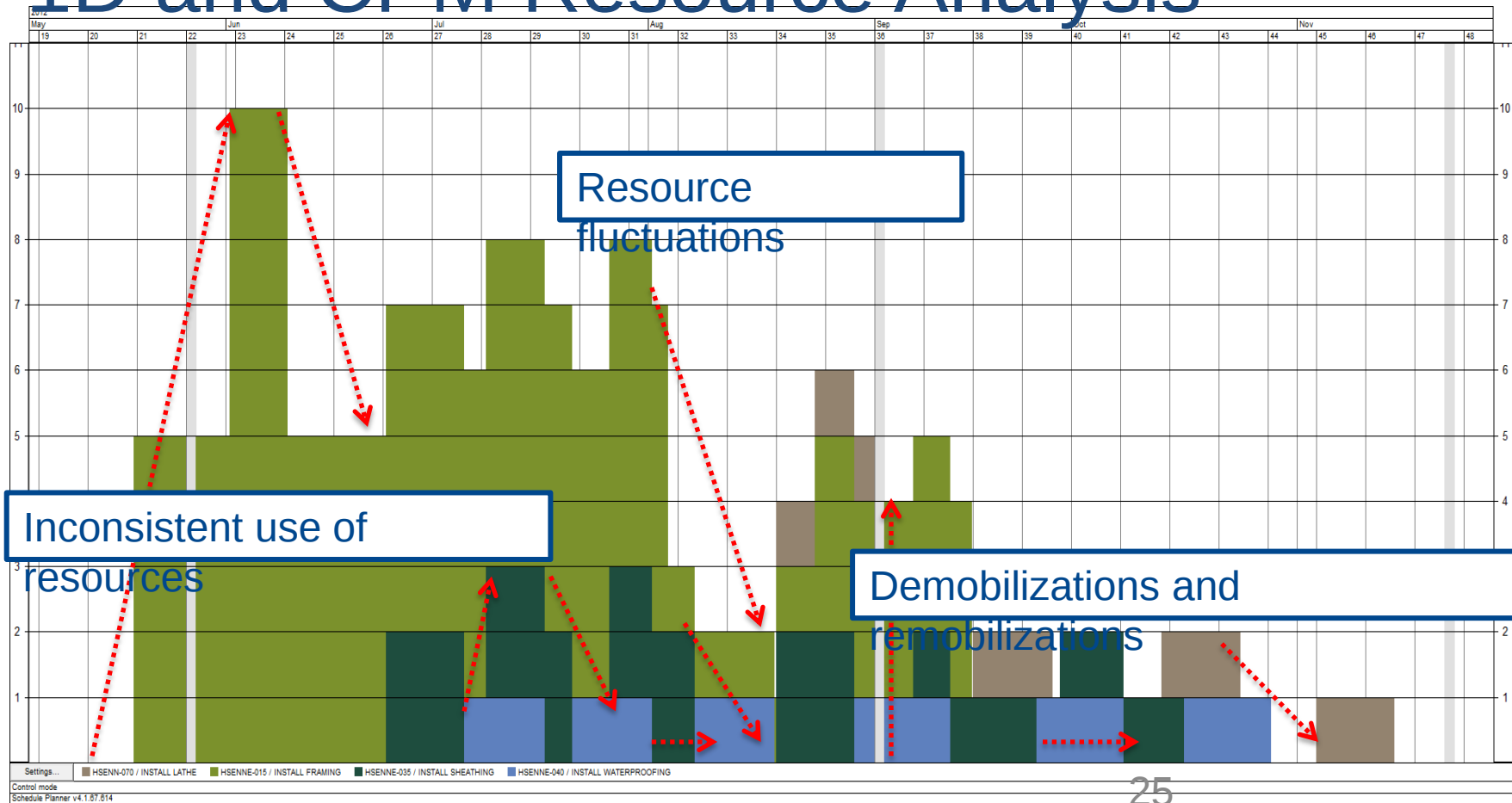
Outpatient services, specialty medicine, Neonatal Post-Operative Care unit, wellness healing gardens

SPECIALTY MEDICAL OFFICE BUILDING

CPM Schedule Alignment



1D and CPM Resource Analysis



1D and CPM Date Review

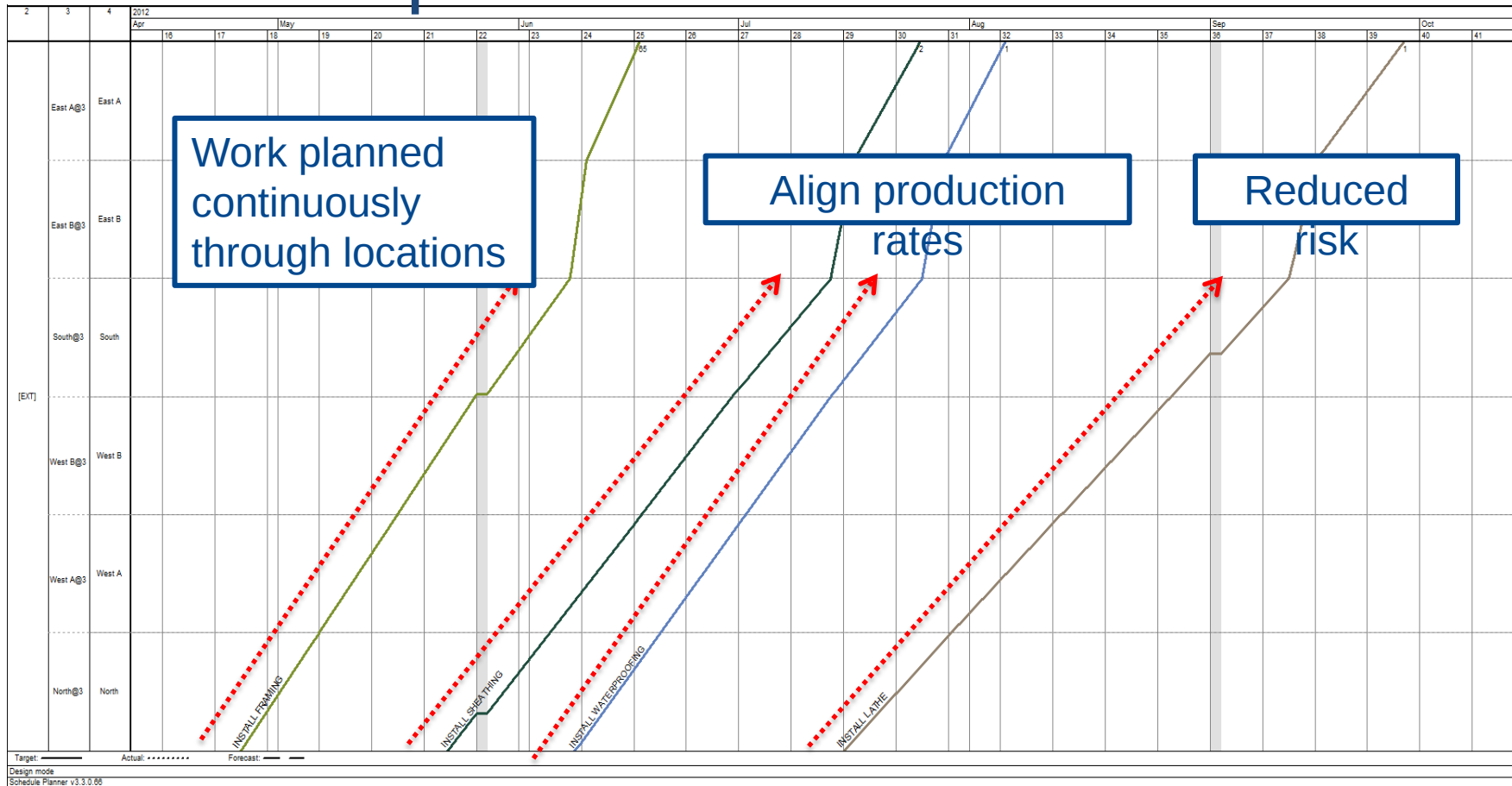
Act Code	Act Name	ES	EF	P3 Start Δ
HSENN-035	INSTALL SHEATHING NORTH ELEV	07/27/2012	08/07/2012	
HSENNW-011	INSTALL SHEATHING WEST ELEV A	08/08/2012	08/17/2012	-1
HSENSW-035	INSTALL SHEATHING WEST ELEV B	08/20/2012	08/29/2012	-3
HSENS-035	INSTALL SHEATHING SOUTH ELEV	08/10/2012	08/10/2012	-12
Act Code	Act Name	ES	EF	P3 Start Δ
HSENN-040	INSTALL WATERPROOFING NORTH ELEV	08-Aug-12	17-Aug-12	
HSENNW-012	INSTALL WATERPROOFING WESTELEV A	20-Aug-12	29-Aug-12	-3
HSENSW-040	INSTALL WATERPROOFING WESTELEV A	30-Aug-12	12-Sep-12	-1
HSENS-040	INSTALL WATERPROOFING SOUTH	24-Sep-12	03-Oct-12	-12
Act Code	Act Name	ES	EF	P3 Start Δ
HSENN-070	INSTALL LATHE NORTH ELEV	26-Sep-12	05-Oct-12	
HSENNW-018	INSTALL LATHE WEST ELEV A	10-Oct-12	19-Oct-12	-5
HSENSW-070	INSTALL LATHE WEST ELEV B	23-Oct-12	01-Nov-12	-4
HSENS-070	INSTALL LATHE SOUTH ELEV	16-Nov-12	29-Nov-12	-15
HSSML-155	INSTALL LATHE	15-Nov-12	26-Nov-12	14
HSNIC-135	INSTALL LATHE-NICU CTYD	03-Jan-13	10-Jan-13	-38

Comparison: 1D+CPM vs. 4D-5D

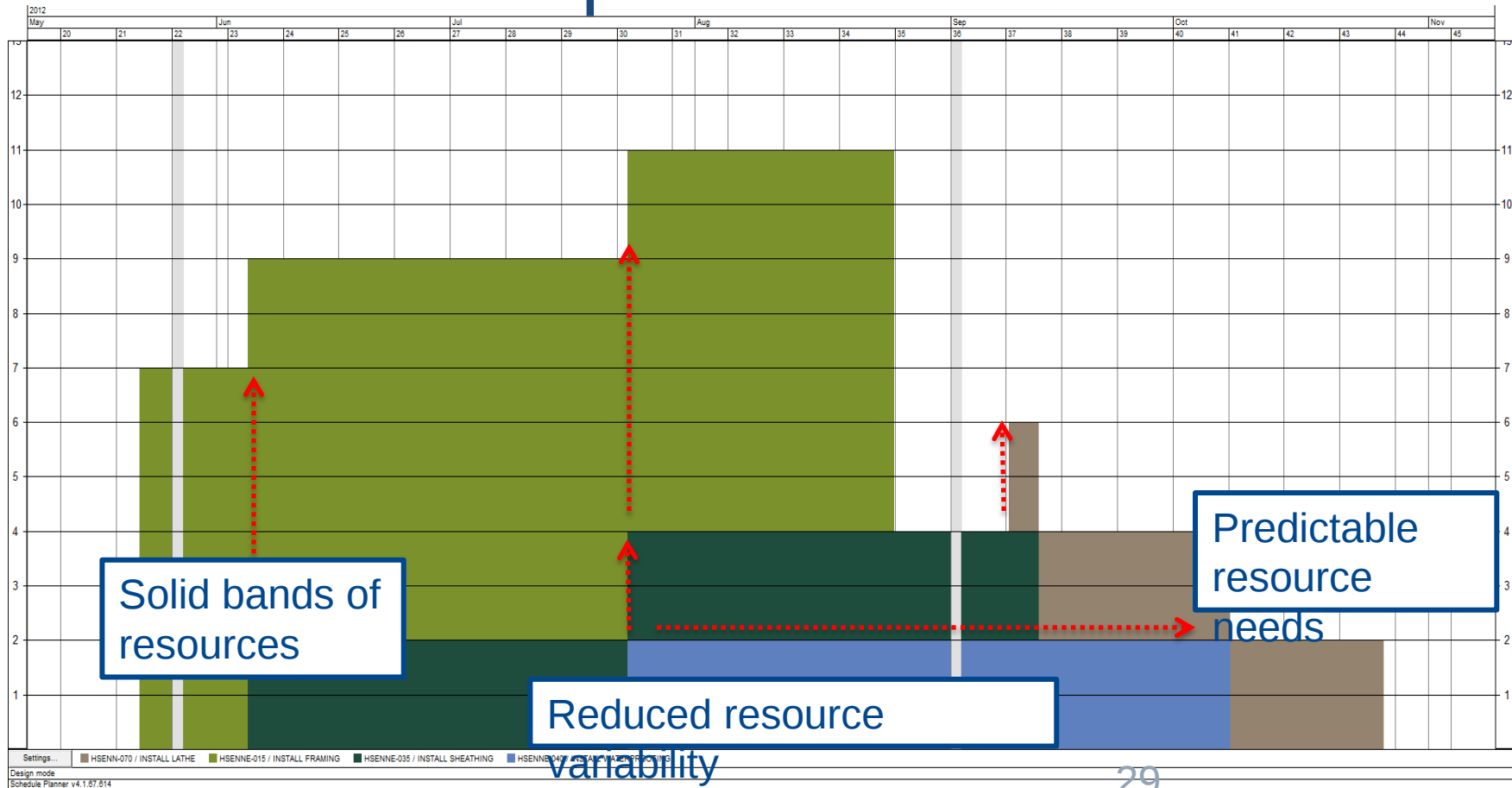
	1D and CPM Schedule				4D-5D Integration			
Subcontractor (by schedule task)	Peak Resource Use	Direct Cost	Mobilization / Demobil. Cost	Waiting Cost	Peak Resource Use	Direct Cost	Mobilization / Demobil. Cost	Waiting Cost
		ROI on Direct Labour	ROI on Mobilizations	ROI on Waiting		Cost (\$)	Cost (\$)	(\$)
	Install Lathe					\$0,330	\$20	-
	Install Framing	34%	\$123,200 99%	903 100%	Savings	\$1,220	\$20	-
	Instal Sheathing	\$205,942	\$169,924	\$180,835	\$556,701	\$320	-	-
Install Waterproofing	3	\$106,011	\$35,520	\$26,442	2	\$70,674	\$347	\$433
	Totals	\$600,247	\$172,031	\$181,268	Totals	\$394,305	\$2,107	\$433

NB: Generic Cost data (Source: RS Means 2010) has been applied to preserve the indemnification of the General Contractor on this case project

5D Time Optimization



5D Resource Optimization



Case Study: Learning's

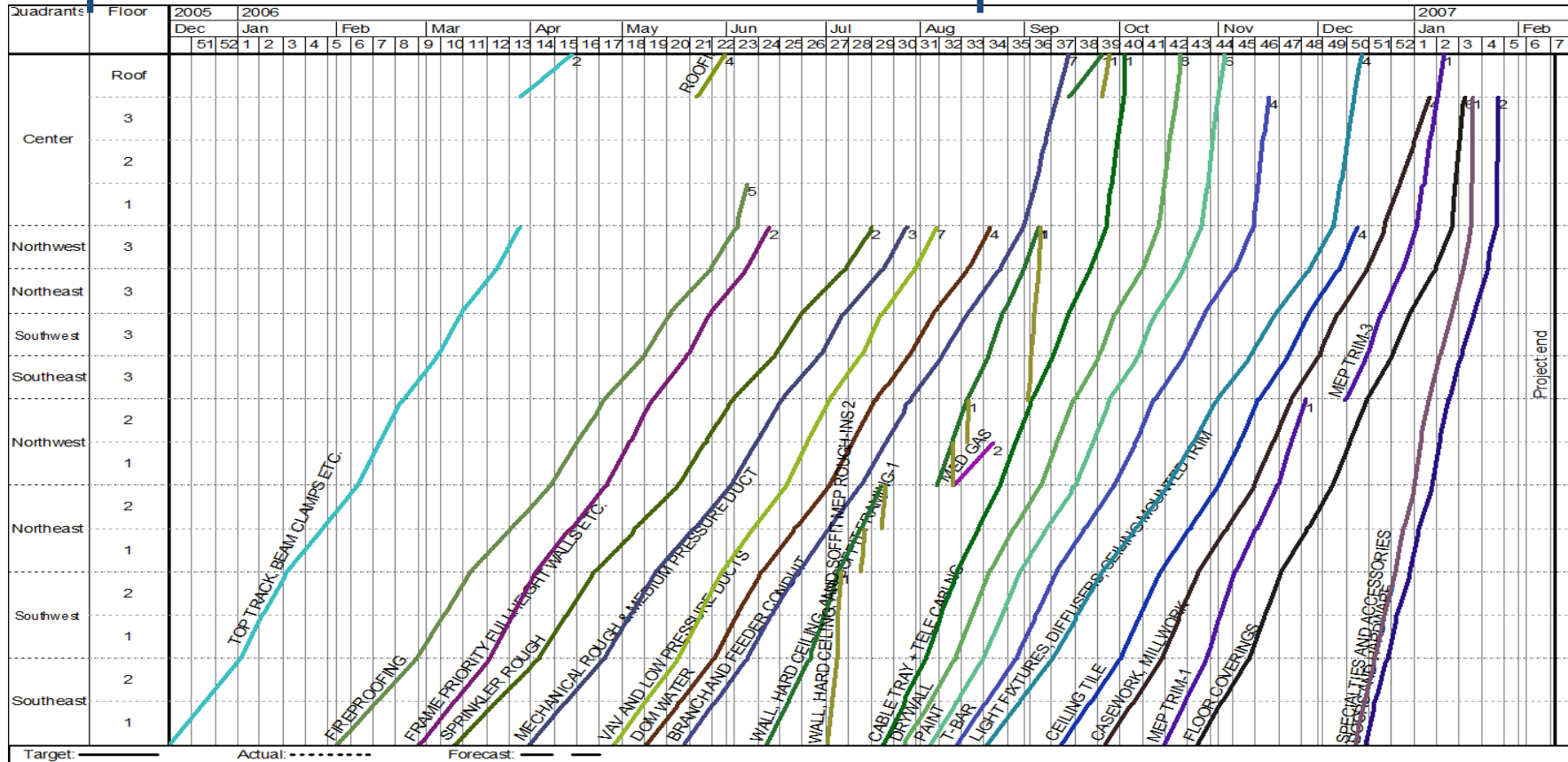
- **Directly impacted the site logistics plan**
- **Reduced Owner Compensated Insurance Plan costs (OCIP)**
- **Reduced Constrictor's Compensated Insurance Plan (CCIP)**
- **Transparency of BOQ, 5D Cost and 4D time at the workplace**



Hospital in Mountain View California
395-bed hospital
Located on a 41-acre campus in the heart of Silicon Valley

CAMINO HOSPITAL PROJECT

Optimization: 1D + CPM compared to 5D+4D



Optimization: 1D + CPM compared to 5D+4D

Subcontractor	1D and CPM Schedule				4D-5D Integration			
	Peak Resource Use	Direct Cost	Mobilization / Demobil.	Waiting Cost (\$)	Peak Resource Use	Direct Cost	Mobilization / Demobil. Cost (\$)	Waiting Cost (\$)
		ROI on Direct Labour	ROI on Mobilizations	ROI on Waiting		Savings		
Casework	0	\$231,680	\$2,800	\$43,397	8	\$185,344	\$1,280	-
Ceiling tile	1	\$16,320	\$1,600	\$18,000	12	\$345,076	\$1,920	-
Doors, frames, hardware	0	\$19,000	\$1,600	\$19,600	4	\$152,000	\$640	-
Drywall	0	\$735,600	\$10,900	\$245,227	10	\$604,920	\$4,800	\$120,049
Electrical	4	\$11,840	\$1,600	\$123,397	10	\$1,046	\$2,080	\$2,598
Fireproofing	0	\$21,000	\$1,600	\$22,600	0	\$12,000	\$1,600	-
Flooring	0	\$24,480	\$1,600	\$26,080	12	\$2,000	\$1,920	-
Mechanical	11	\$405,600	\$8,000	\$50,613	11	\$405,600	\$3,040	\$19,720
Paint	6	\$181,760	\$5,760	\$106,020	6	\$181,760	\$960	-
Plumbing	3	\$109,480	\$1,760	\$14,133	6	\$218,960	\$960	-
Specialties	3	\$49,640	\$1,493	\$7,253	1	\$16,547	\$160	-
Sprinkler	3	\$98,000	\$1,813	\$37,973	2	\$65,333	\$320	-
Totals		\$3,349,000	\$85,759	\$983,309	Totals	\$3,104,986	\$19,680	\$142,367

NB: Generic Cost data (Source: RS Means 2010) has been applied to preserve the indemnification of the General Contractor on this case project

What was the result of implementing integrated 5D?
How did we focus our effort to achieve success?

IN SUMMARY

Observations

- **Proactive problem solving**
- **More efficient reporting structure**
- **Emphasis on tracking and monitoring 5D production**
- **Detailed documentation of production deviations and remedies**
- **Negative project impacts – cost, quality and time**
 - associated to not doing integrated 5D to field

The Proof is...

- **What do we need to understand to get 5D to the workforce?**
 - Dissemination of the information that matters to those that are using it
 - Consider cost/benefit of demobilization of resources relative to risk management
- **What trends am I observing?**
 - Analogue process in construction; digital disruption through BIM
 - Connecting the hearts and the minds of traditional delivery with

the Pudding.

- **What questions do I have around 5D?**
 - Understanding the emotional and political motivations to use 5D/4D/3D/2D over 1D
 - How do you create the silo experience that results in the integrated approach?
- **What are the next steps for the industry?**
 - Innovation will result in impacting the already low profit margins
 - Consider the bigger organizational impr(m)ovement
 - Be afraid of the nimble early adopter