Working with Proposals in InfraWorks 360

A discussion of how to use proposals to present alternate designs in collaboration with a team.

A white paper from the Autodesk Infrastructure Team

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Introduction
An InfraWorks 360 model allows you to easily aggregate your own GIS data or build an initial model with Model Builder to create a starting point for your designs. InfraWorks 360 also provides some unique solutions for exploring alternate design concepts. This paper suggests workflows for using proposals to create those alternate designs and highlights some issues to be aware of, so you can maximize your productivity.

Proposals are useful, not only for separating out multiple design alternatives, but also for separating out the work that each team member does when co-editing the same model. In this paper, we will also show how proposals can be used as “sandboxes” for team collaboration and project review.

The Master Proposal
A proposal is a working document that contains all your data. Every model is created with an initial proposal known as the master. The master is the primary working document for your design. You can create your entire design in the master, but you may wish to explore multiple design ideas and that is hard to do in a single document. More importantly, you may wish to retain a view of things “As Is” (the current state), so that it can be compared to the new design.

We recommend capturing the “As Is” state in the master and then creating a new proposal to capture a design concept. In this case, let’s assume you plan to design a new shopping mall. You would create a new proposal called NewMall based on master and then continue adding new design features to the NewMall proposal. You can switch your view back and forth between master and NewMall to inspect the differences.

The Proposal Hierarchy
Once you’ve edited the master until it reflects the starting “As Is” for your project, you can then explore multiple design alternatives. Make sure you create each design alternative as a new proposal based on the master. This has benefits should you ever need to update the master to reflect changes to the “As Is” state and propagate those changes to the proposals.

It’s possible to create a proposal from another proposal. You can think of this structure as an upside down tree, with the master being the root and different designs branching from it and each other. A branch is a point in time defining the creation of a proposal.

When referring to proposals, sometimes the terms parent and child are used. In the diagram, master is the first parent. Design1, Design2, and Design3 are children of the master. Design2_1 and Design2_2 are children of Design2, making Design2 a parent as well.
NOTE:

1. Once a proposal is created it cannot be renamed. If you need to rename a proposal, create a new one with the correct name from the one with the incorrect name and immediately delete the incorrectly named one.
2. The master cannot be renamed or deleted.
3. For technical reasons, proposal names must be unique and cannot contain spaces, periods, or special characters. Exceptions are underscore “_”, hash tag “#”, and Unicode characters.

Figure 2
Proposal Basics

In InfraWorks 360, a new proposal begins as a snapshot of the current active proposal at that point in time. The active proposal is the one currently being viewed.

NOTE: Only one proposal can be active (viewed) at any time.

This snapshot does not actually make a full copy of all the data, but it captures the history of revisions in the active proposal. What is meant by a history of revisions? This means the proposal isn’t simply a copy of the data, but a record of the edits (or diffs) which define the proposal up to that point in time. This becomes important when merging (combining) proposals.

You can think of a proposal as a series of actions that take place at different points in time. Let’s assume your model has only a master proposal:

1. New empty model created with a default proposal called master
2. Data is imported
3. Some edits are made
4. Something is deleted
5. More edits are made
6. And so on...

![Figure 3](image)

When you create a new proposal, it branches at a point in time from the parent, allowing for different edits to be made in each proposal. Think of this as a tree with two branches.

![Figure 4](image)

When looking at the revision history for the NewMall proposal, it contains the first 4 actions from the master plus two unique changes that are different from the two actions that took place in the master after the branch. Actions 6 and 8 do not appear in NewMall and actions 5 and 7 do not appear in the master.

Working in another proposal is almost like working in the master. You can import new data, sketch, edit or delete data, and do pretty much everything you can do in the master proposal. However, proposals are also like database views: each proposal provides a different view of the underlying data.
NOTE:

1. Any changes to a parent proposal are not automatically reflected in its children. If one or more proposals were created, but updates have continued in the parent, these are not automatically pushed down to the children. You must manually merge those changes into each proposal. This will be covered in more detail in the Merging Proposals section.

2. The SQLite database for the model is also a view of the underlying data. When you switch between proposals, the SQLite file is regenerated to reflect the current active proposal. When a model contains proposals other than master, there is no single human-readable version of the entire model database available.

3. Each proposal has its own tile cache (the generated map-like terrain tiles for displaying the model). The more proposals a model contains, the more disk space it will consume.

Some assets of the model are shared by all proposals and are not unique to each proposal:

- Bookmarks
- Model Properties
- Model Explorer settings
- Watermarks
- Storyboards
- Themes
- Scenario Definitions
- Styles
- Style Rules

This means these can be defined once and used in every proposal. When collaborating, the Sync dialog lists these assets as a single item known as Common Resources.

**Collaborating with a Team**

InfraWorks 360 supports sharing a model via the cloud, so that other people can work on the same model without actually working on the same physical file at the same time. This avoids the common locking problems associated with single-file applications. Multiple people can collaborate via the cloud and work in the same proposal if they wish. Syncing via the cloud allows each person to exchange their changes with each other when they’re ready to do so. If you do not create proposals, then all work is being done in master. If people decide to create proposals, these can also be shared via the cloud just like the master.

NOTE: Multiple people can work in the same proposal, however this does not prevent people from editing the same content. Editing the same feature creates what is known as a conflict. This will be discussed in more detail in Workflow #3 — Using Proposals to Reduce Conflicts.
Workflow #1 – Multiple Designs Based on Master

Let’s discuss the first recommended workflow: creating multiple alternate designs based on master. If you want to explore a design for a new shopping mall, create a proposal from the master called NewMall1 (assume master was prepared to reflect the “As Is” state of the world as discussed earlier). In the NewMall1 proposal, you can sketch, import, and edit data to reflect the new design.

If you want to explore a second design with different buildings, entrances, and parking lot layouts, you can create another proposal from the master called NewMall2. Creating a separate proposal from the master inherits the “As Is” state of the master, but excludes the changes in made in NewMall1.

NOTE: Remember, for this workflow you must always switch to the master before you create a new proposal.
**Workflow #2 – Creating Proposals from Other Proposals**

It is entirely possible to create proposals from other proposals and there may be reasons for doing so. There is more than one way to do this, depending on how much the proposals might differ.

The previous workflow discussed how completely different designs for the new mall with different buildings, entrances, and parking lot layouts can be created in different proposals. These designs share almost nothing in common other than the “As Is” state defined in the *master*.

In this next example, assume you have three designs. Two designs are similar, but have different entrances than the first and require different building and parking lot layouts. Since designs two and three are based on a similar starting point, instead of creating the third design from the *master*, create it from NewMall2 and make the required edits, hopefully reducing the time it would take to create the design from scratch.

![Diagram](image-url)
In the next example, assume all three designs are variations based on the same initial layout with only minor changes. This would result in the following structure:

![Diagram](image)

Deciding the best approach isn’t always obvious. The differences between the designs could be as simple as different building facades and street decorations suggesting the vertical approach in Figure 8. But if the building layouts, road, and parking infrastructure differ greatly in at least one case, then Figure 6 or 7 may be a better approach. Creating a proposal based on another may involve more editing than expected. When in doubt, keep it simple.

NOTE:

1. This workflow requires you switch to the correct parent before creating a new child.
2. The user interface does not currently display the proposal hierarchy or a proposal’s place in the hierarchy. It’s easy to get confused about which proposal was generated from another and, unfortunately, the interface doesn’t clarify this relationship. When creating a new proposal, you should ensure you’re viewing the correct parent from which you wish to inherit.
3. If you plan to create many proposals based on other proposals, you may wish to document your hierarchy outside of InfraWorks 360 or use a naming convention that suggests the hierarchy. In all the prior examples, notice how suffixes in the proposal names help to suggest the relationship between proposals.
Workflow #3 – Using Proposals to Reduce Conflicts

When more than one person is collaborating on a model, the chances of two people editing the same features increases significantly. When two people make edits to the same features it is called a conflict. If each person is working in the same proposal, there is a higher chance of conflicts being distracting or interfering with work on different feature classes.

Using proposals as independent sandboxes helps to avoid these conflicts to some degree. If people do edit the same feature, dealing with the conflict happens automatically when you Sync or Merge. This will be discussed in the Merging Proposals section. A common example of this approach might be people working on different infrastructure components.

![Diagram](Figure 8)

Figure 9 suggests that once the master is prepared to reflect the “As Is” state, separate proposals can be created to work on specific infrastructure components. A benefit of this approach is that each person can work on their features independently, with or without the intent to eventually consolidate designs by merging their proposals. Assuming the master already contains features from multiple feature classes, such as roads, drainage, buildings, and trees, you can create different proposals to work on individual feature classes. Once the designs are complete in each proposal, they can be merged to make it appear like they were all built together. When collaborating, it’s possible for multiple people to work on the same proposal, so even separating things based on infrastructure does not prevent multiple people from working on the same components.

Another possibility is that the project is happening in an area with no infrastructure in place (for example, a new subdivision). The master may contain only a base terrain, orthophotos, and perhaps an access road. If that is the case, there won’t be any need to hide content because each proposal will contain independent content that may eventually be merged.

NOTE:

1. Model Explorer and Surface Layer settings apply to all proposals, so if you sync your models to the cloud, when one person changes any of these settings, the others will get these changes the next time they Sync. This is a result of these settings being shared as Common Resources. If you hide feature classes, syncing or merging may keep changing these settings.
2. We do not recommend that you delete feature data or their data sources to get them out of your view in your proposal. The delete will be remembered on the next merge, and will likely remove those same features for the rest of your team.
3. Workflows 1 and 2 can be combined to allow for multiple design concepts, but this can get very complicated very quickly. This is an advanced workflow that is discussed in the *Advanced Workflow – Collaborating with Large Teams* section.

**How to Create a Proposal**
Currently there two ways in InfrWorks 360 for creating proposals. One way is the Proposal dropdown in the Utility bar at the top of the application. This is a quick access point for switching between proposals, creating proposals, and deleting proposals.

![Proposal dropdown](image)

*Figure 9*

**NOTE:**

1. The above control is very convenient, but it also has some drawbacks. It’s very easy to switch between proposals or create new ones. However it’s also too easy to create a new proposal from the wrong proposal when the current proposal is not the desired parent. **Always consider which proposal is current before creating a new one.**
2. The above control also lets you delete a proposal without switching to it. This makes it easy to delete proposals without actually viewing them. Thankfully there is a warning dialog to ensure deleting the proposal is what you want.
The second way to create a proposal is using the Proposals panel found under the big I in the toolbar:

![Proposals panel](image)

**Figure 10**

The Proposal panel provides additional capabilities and information about the current proposal and how it has changed relative to the *master*. The panel provides statistical details about various features to help understand the impact of the design changes relative to the “As Is” state (for example, how much additional road length or area of various features has been added or removed). The panel is also used to switch between, create, delete, and merge proposals.

**NOTE:**

1. As of the InfraWorks 360 2016 releases, the Proposals panel supports reporting differences only between the current proposal and the point it branched relative to the *master*. This means you can compare any proposal to the “As Is” state should you choose to capture that in the *master*.
2. You cannot compare one user-created proposal to another.
3. If you don’t use the *master* to capture the “As Is” state, then the differences report may not have a lot of statistical meaning. But it still provides an itemization of changes compared to the *master*. 
4. If you make changes to the *master* after you create a proposal, the differences report will show changes from the time the proposal was branched, not the current state of the master. If you make changes to the *master* these changes can be merged into your proposal to update it (see the next section). The differences report walks back through the tree to the last merge point of the *master* to compare the revision history. The next section will discuss this in more detail.

5. If you have created multiple tiers of proposals, the differences are always between the *master* and the current active proposal. This means the comparison looks at the revision history for current proposal and the *master*. If changes have been made to any of the parent proposals in the chain, these are not included. Only the changes that were present at the time each proposal was branched from its parent are compared. The next section will explain this in more detail.

**Merging Proposals**

The ability to combine any two proposals is a powerful feature in InfraWorks 360. Merging allows you to make changes to any proposal (the source) and blend those changes into any other proposal (the target). In workflows where you create proposals from *master*, the *master* usually reflects the “As Is” state. If further changes to more accurately reflect this state are made, it’s likely those changes need to be reflected in the design proposals that have already been created. Merging will resolve this.

Merging also has benefits when using Workflows 1 and 3. This approach involves separating different aspects of the design into different proposals. Separating design concepts is useful for visualization or productivity, but it’s also useful to bring them together to create Storyboards (walkthroughs) or to present a consolidated final view of the overall project. The Merge feature can be used to do this too.

The Merge feature can be found in the Proposals panel. As you go through this interface, play close attention to which proposal you’re merging from and which proposal you’re merging into.

![Merge Feature](image.png)

*Figure 11*
Workflow #4 – Merging From Master to Proposals

The following shows a revision tree and the time various actions take place:

After the master was created, some changes were made to the model. NewMall1 was created at a point in time after change 4. Some changes were made in both proposals after the fact. The changes are independent of each other. In step 5, you imported a 3D model of the new mall and in step 7 you edited the roads to create an entrance to the parking lot.

The dashed line (B2) above represents the point in time when the master proposal, the source, is merged into NewMall1, the target. This means that any changes that have taken place in the master since NewMall1 was originally branched (B1) from master are blended into NewMall1.

In the original design of the new shopping mall, the master proposal contains a series of actions through step 4 to build the “As Is” state. NewMall1 was created and work progressed on the new design. At some point some additional updates had to be made to the master to add trees (step 6) and improve some road styles (step 8) to better reflect the “As Is” state. However those changes should also be reflected in the NewMall1 design. Remember the earlier note: “Any changes to a parent proposal are not automatically reflected in its children.” In order to apply these changes to NewMall1 you must use the Merge feature in the Proposals panel. A merge attempts to take the outstanding changes that have taken place in a proposal (master in this example), and apply those changes into another proposal (NewMall1 in this example). The merge takes changes from the source (the selected proposal) and applies them to the target (the proposal currently being viewed). The terms Source and Target are used to help clarify where data is coming from and going to. The merge will update the revision history and it will appear as if the branch took place later.

As you can see from the above diagram, it looks like changes 6 (trees added) and 8 (roads edited) also happened in NewMall1 and a second newer branch point (B2) has been added after step 8. In the future when the proposal panel shows the difference between NewMall1 and the master, the only difference will be steps 5 and 7. The most recent branch point will be used when the difference report is presented in the Proposals panel. Note that the changes shown above are independent of each other and affect different features: in other words there are no conflicts.
As discussed earlier when the difference report is generated, it walks back through the tree to find the revision history of the current proposal and compares it to the *master*. Consider this revision history:

![Diagram](image)

The difference report when viewing NewMall2 in the Proposals panel will contain revisions 4, 6, 8 & 9. Revisions 1, 2, 3 & 5 are common to *master* and the other 2 proposals after the last merge (B2) between *master* and NewMall1. Changes 4 & 6 are included in the report because these are inherited from NewMall1, the parent. Change 7 will be ignored as this takes place after the last merge between *master* and NewMall1. As you can see, tracking the history of changes can be complicated.

**Conflicts When Editing the Same Features**

When you make different changes to the same feature in two different proposals and merge those proposals together, a conflict occurs. For example if you delete a building in one proposal, but edit its height in another proposal and merge those two proposals, only one of the edits can remain.

Similarly, when two people make different changes to the same feature in the same proposal and then **Sync**, there is also a conflict. During a merge (Sync is a cloud version of merge) those changes have to be resolved.

**NOTE:** Conflicts are resolved automatically. There is currently no mechanism for people to decide which change should take precedence.

After the merge, one of two things will happen. If the building was deleted in the target, the edit which took place in the source will be lost. If the building was edited in the target, the delete in the source will be ignored. During a merge the source changes are blended into the target. **In cases of conflict, the target wins.** If there are no conflicts the source changes are simply accepted. **In a Sync, local changes generally win over changes in the cloud.**

The above behavior sounds simple enough, but if you don’t keep track of your proposals, in particular which ones you merge, you might get confused. For example if you delete a feature in proposal2, but edit the same feature in proposal1 and then you merge proposal1 into proposal2, the edit will be lost. If you subsequently make changes in proposal2 and merge that back into proposal1, because of the prior merge, the feature will be deleted in proposal1 because the history of edits is applied. **We don’t recommend merging two proposals back and forth between each other.**
Workflow #5 – Merging into a Separate Proposal (Recommended)

Here’s an example based on creating multiple designs based on master, but instead of two different versions of the new shopping mall, let’s make one design a new subdivision and the other the new shopping mall.

![Diagram showing master, NewSubdivision, and NewMall]

Figure 15

If you want to create a final presentation using a Storyboard that shows off both sets of changes, you can combine these results in several ways. The simplest and safest way to combine two (or more) proposals is to create a new proposal from master, call this one FinalDesign, and merge NewSubdivision and NewMall into FinalDesign.

![Diagram showing master, NewSubdivision, NewMall, and FinalDesign]

Figure 16

By combining these into a new single proposal, you can switch between each original proposal and view the changes in isolation, as well as the combined result. If you’re not concerned with preserving the “As Is” in the master, you could simply merge both proposals into the master, but this is not recommended because of the loss of the “As Is” state.
NOTE:

1. Merging proposals into each other may produce unexpected results and the merge cannot be undone. We recommend merging proposals into a new proposal, preserving the originals.
2. Merging back to the master would result in the loss of the “As Is” state. If you plan to merge back to the master, we recommend that you first create a new proposal from the master called AsIs as a backup for creating additional concepts from the original state.
3. You may get different results if you merge NewMall into the FinalDesign before NewSubdivision and vice versa. This is why we create the new proposal to validate the result, without making irreversible changes to the original proposals.

Advanced Workflow – Collaborating with Large Teams

Previous workflows can be extended to work with larger teams and multiple project review phases.

![Diagram showing workflow with various proposals and design iterations.](image)
In the above example, you can merge several proposals (the dashed lines) into an intermediate proposal to consolidate work at the end of a regular review cycle or to provide a snapshot at the end of a design/construction phase. Follow the basic rules and create the intermediate proposals from the master. This intermediate proposal becomes the “Completed” state for starting the next cycle – similar to using the master for the “As Is” state.

The use of proposals also preserves an audit history of the project over time should you continue to track the project past the initial design phase and possibly through the several construction phases. You should name proposals in a meaningful way that helps imply their relation to each other, or you could diagram the hierarchy of the proposals elsewhere.

NOTE: Again InfraWorks 360 does not currently have a visual representation of the hierarchy, hence the suggestion to document it.

Conclusion

As you can see, InfraWorks 360 provides lots of flexibility when working with proposals. With that flexibility comes some manual work to keep changes consistent between proposals. Following some basic rules of thumb should help to avoid the confusion that can arise when working with proposals:

1. Preserve an “As Is” state.
2. Create new proposals from master whenever possible, for more predictable results.
3. Avoid merging proposals into each other whenever possible.
4. Merge two proposals into a new one created from master whenever possible.
5. Merges can vary depending on which proposal is the source and which is the target. In a sync, local changes generally win over changes in the cloud.
6. When editing, be aware of which proposal you’re in. Some people forget and create new proposals off an unintended one, or they mistakenly edit someone else’s proposal.
7. The Proposal panel shows differences from the master, not between proposals.
8. Adopt a naming convention to imply the proposal hierarchy and identify parents and children.
9. Document and diagram the hierarchy for more complicated workflows.

We have shown the power of proposals both in presenting design alternatives and in providing collaborative sandboxes. Along with this power comes some complexity. We hope these guidelines help you choose the best ways to use proposals for your business needs.