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## A New Methodology for the Quality Control Review Process for Roadway-Engineering Plans: A Case Study

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Engineering Management
Field Project

# A New Methodology for the Quality Control Review Process for Roadway-Engineering Plans: A Case Study

By

Braden R. Beamer
Master of Science in Engineering Management
The University of Kansas

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An EMGT Field Project report submitted to the Engineering Management Program
and the Faculty of the Graduate School of The University of Kansas
in partial fulfillment of the requirements for the degree of
Master of Science.

Herb Tuttle Date
Committee Chairperson

Linda Miller 5-7-19
Linda Miller Date
Committee Member

Tom H. Bowlin 5/7/19
Tom Bowlin Date
Committee Member

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## Executive Summary

This field project report provides an analysis and evaluation of an alternative quality control method to the traditional quality control methods for the conformation of engineered roadway plans against the various standards of design. The new method will shift the timing and method of quality control review of engineered roadway plans in such a way that overall effort is decreased, checking process duplication is eliminated, and comment resolution is well documented and tracked for closeout. The report finds that when the quality control process is completed in synchronization with design, and not at the end of design, major design flaws will be found sooner, and the likelihood of project delay is decreased. It is recommended that the new method of quality control be applied to all future roadway design projects. This report also makes note of some of the limitations of the project. Some of these limitations include the unique nature of the project being an intersection improvement project without structural design components, the small footprint of the design, and general improvement of an existing condition vs. a brand new design from scratch. Another limitation of the project is that there are no true metrics to record the traditional quality control methods to compare to the updated method. It does not make economic sense to budget a project to be reviewed two times, with one based on the original method, and the other based on the proposed new method.

## List of Principal Symbols and Nomenclature

QC – Quality Control Review
QA – Quality Assurance
DC – Detail Check Review
CAD – Computer-Aided Design
DQMP – Design Quality Management Plan
EIT – Engineer In Training
DOT – Department of Transportation
FHWA – Federal Highway Administration
Cloud Note – A note that brings attention to a topic for discussion
PDF – Portable Document Format

## Introduction

Before a set of roadway plans can be submitted to a client, the plans will need to be reviewed. This is because there is normally a legal binding contract that states that the engineered plans must be checked for any errors to ensure safety to those citizens whom the project will affect. Not only is this a requirement of the clients but also a requirement internally at the aurthor's company. XYZ requires that all sets of plans need to be reviewed to catch any errors that may result in unsafe designs, or designs that will result in constructability of a project being hindered, which can increase the cost to build. Other than being required, it is also the right thing to do, and would be a breach of the engineering ethical code not to.

If an engineer has a project submittal to a client in one month, then one month before that submittal date, the plan set will go into a QC review. The review process is divided into two different parts, the QC review and the DC review. The QC review refers to an unbiased look at the roadway plan set as a whole. This means that someone not familiar with the project will be the one to look at plans. What this person looks at is the general design of the project. The check is performed to make sure that there is coordination between disciplines in the plan set, and to

make sure that all the required information that is needed on each sheet is shown. This is done to make sure that the information shown on one page of the plan set will match information on any other sheets where similar design information is displayed. The design information needs to be consistent throughout the plan set.

The DC review refers to the checking of all calculations and design specifics to make sure they are compliant to all federal and local standards. This part of the QC check is performed so that every callout, and every number on a plan set is checked for design accuracy. This is normally performed by checking all the calculations that have been compiled against an agreed upon design criteria that will have been established with the client, based on the federal and/or local standards. When there are elements of design outside of the design criteria, then one will default back to the specific standards for either the state or federal design standards.

When detail checking and QC of engineered roadway project plans overlap during the end of a project schedule, any of these checks resulting in the need for a redesign of a project can be detrimental. Redesigns, in any capacity, can result in many hours of work needed to follow the changed design through the project. Since this typically has been occurring near the submittal deadline, increased workweek hours have risen. This is because once the detail checks have been addressed, the updated plans will need the QC review. So once this process is pushed near the deadline, either the schedule will be missed, or employees will have to work overtime to hit the deadline. All of this will increase project cost.

This generally results in a rushed effort in either the DC or the QC. Rushing this effort leads to errors, and errors result in an unsatisfactory product. This can cause safety concerns, and can even make a client not want to work with the firm again if the errors are severe. For this reason, the author believes that the detail checking should be done in concurrence with design, and not at the end, so that the only aspect being checked towards the end is the fluidity of the plan set, and not the actual design. In addition, there needs to be a line of accountability between the person originating the work, the person checking the work, updating the work, and finally the person responsible for making sure the work was updated correctly. This will ensure that all the comments were identified accurately, and will provide documentation to who approved the changes if any project is audited, or if anyone, such as the client, has any design change related questions.

## Literature Review

A literature review was completed for this research project using books, articles, and website. Due to the nature of this research paper being very specific to one discipline in civil engineering, it was challenging to find any documents of this type of methodology. The author was able to find a number of resources that deal with the field in general, and was able to apply those principles to the updated approach. Along with guides provided by XYZ (the company), the author was able to apply both the internal company resources, with external resources, to combine with their personal professional experience with roadway-engineering plans to develop this paper. Evaluations of several resources used for the paper are described below:

## *Project Management*

*A Guide to the Project Management Body of Knowledge (PMBOK Guide)*. Fifth ed. Newtown Square, PA: Project Management Institute, 2013.

The Purpose of the PMBOK Guide is to break down the process of project management into different components that can be generally applied to any sort of project, which follows the project management approach. This book also offers a good lexicon base to be used in the project management approach as a whole. This book breaks a project down into its most fundamental elements in such a way that it can be applied to projects of all disciplines and scopes. This book serves as the base to the concept of project management in engineering, and as the fundamental core to this research project.

Burstein, David, and Frank Stasiowski. *Project Management for the Design Professional: A Handbook for Architects, Engineers, and Interior Designers*. New York: Whitney Library of Design, 1991.

Although this book is approaching 30 years since it was published, the material it provides is still useful and accurate for today's project management approach. This book categorized the project management approach in the engineering field into its most basic components. This book also serves as a guide on how to complete different within the project for engineering. There are numerous examples on how to fill out a project schedule, scope, budget, and how to manage a project team to stay on schedule, budget, and scope. This book focuses on specifically

engineering project management components that have remained unchanged for years, and provides excellent examples on how to create the different components necessary for an engineering project.

Plummer, Frederick B. *Project Engineering: The Essential Toolbox for Young Engineers*. Burlington, MA: Butterworth-Heinemann, 2007.

The content of this book is to familiarize recent engineering graduates on the ins and outs of an engineering project fresh out of school. A new graduate may not have any experience on what project engineers do, how projects work, and this book does a good job to give a new engineer a crash course on how the engineering profession. This book offers several case studies into engineering projects. Additionally this book provides advice on how to be confident and competent, and how to be a well-rounded project engineer and how to keep a project moving.

## *Quality Control*

Brown, Jerome. *Quality Management System Manual*. PDF. Omaha, NE: XYZ, Inc., December 29, 2017.

The Purpose of this document is to set the standards for QC management for XYZ. This document provides quality conformance standards for every project for the entire lifecycle of any project. This is from project conception to project closeout. This document serves to list the

company policy on procedures for QC. In addition it provides supplemental documents that need to be filled out during the QC review processes. This establishes a set of standards so that each project has the tools necessary to be completed in a similar way. This allows any engineer, regardless of location, the ability to access the company's quality management process, and to be compliant in all legal standards.

Burati, J. L., R. M. Weed, C. S. Hughes, and H. S. Hill. *Optimal Procedures for Quality Assurance Specifications.*Report no. FHWA-RD-02-095. Office of Research, Development, and Technology, Federal Highway Administration. Accessed April 4, 2018.

The Purpose of this document is to guide governmental agencies in transportation when developing new quality assurance specifications, or modifying existing specifications. This document provides illustrations and instructions to lead the agency through the entire process of the acceptance of plan development. From an engineering prospective this document helps to guide the engineering staff on what types of QA procedures the FHWA has lined out for local DOT's that XYZ may work with, and will help the engineer out in the field condition know what QA practices are acceptable to the DOT.

## Research Procedure

The research project was done to enhance the original methodology of the QC and DC procedures. The goal of this project is to design a new, more efficient methodology to the existing procedures for these checks to roadway-engineering plans. To do this, each aspect of the design process for a roadway-engineering plan QC/DC was analyzed for areas that could be improved upon. The four areas that were observed for the project are Scope of Services, Fee Proposal/Budget, Procedure, and Documentation. New methodologies were then applied to the four areas to be tested on real world projects, where possible. The following research procedure outlines the original methodology and the proposed new methodology of the QC/DC processes for roadway-engineering plans.

### *Original Methodology*

#### *Scope of Services*

The scope of services for a roadway-engineering project refers to the common understanding between client and consultant as to the work that needs to be completed in order to deliver a project. This is delivered as a written contract that delineates what is in the scope of services. This document clearly lines out what tasks are to be completed in the project, and what deliverables need to be submitted at each stage of design.

According to the PMBOK there are six major scope management processes involved in defining the parameters of the scope. These are a scope management plan, requirement collection, scope definition, work breakdown structure, scope validation, and scope control.

Various clients will require different levels of a scope document depending on the scale of the project. For example, a $40 million dollar highway interchange redesign project will require more defined scope versus a $1 million dollar roadway rehab project. This is because there is more risk for the client when the project is larger in scope.

When first defining the parameters of the scope, it is important to look at the requirements, and sample plans of previous projects for a client as to know exactly what needs to be in the scope for each stage of design. Once the deliverables have been agreed upon, the client will select which deliverables will be required in each submittal of the design process. This task is completed along with the specifications identified by each client. Individual requirements are then defined by what is to be specifically done by the client, so that there is no confusion as what is to be delivered. Next if a job is large enough, or if a client requires it, the consultant will provide a work breakdown structure. This refers to a document that breaks down the project requirements into individual tasks. This document will also be used to help determine the fee and budget. After the document is created then it is submitted to the client for comments and approval. When the client makes comments, the changes can be agreed upon as to what work will need to be done, and for which phase of design. After that is agreed upon, it is the job of the project manager to control the scope so that work is not performed outside the agreed upon scope, also known as scope creep. This is prepared, and revised if necessary, throughout the life

of the project. See Appendix **Figure 1. Sample Scope and Fee (No QC Hours)** for a sample scope that does not contain hours for QC.

## *Fee Proposal/Budget*

A project fee/budget refers to the tool used by the manager of a project to estimate the total cost. For roadway-engineering plans, this specifically refers to the amount of hours required by the engineering staff, CAD staff, and administration to perform the work needed to complete the project. These hours are then multiplied by a rate for each member of the staff to calculate a fee for the design. Along with the labor costs to deliver a project, there can cost associated with travel, meals, and even items such as printing. Any aspect of the job should be included in the project budget. The Fee proposal is the accumulation of the detailed estimates of all costs that are likely to be incurred in the project as the project is being designed.

Originally, the tasks laid out in the work breakdown structure were assigned estimated hours to complete by the project managers. These hours were an estimate of what the PM believed necessary to complete the task. It used to be that these hours were only given as the estimate of the amount of time to do the work for each task, and then the QC of the project was broken out separately for the entire project.

## *Procedure*

With the traditional QC/DC method, the process would begin one to two weeks before the submittal date. This method includes one person assigned to detail check the plan set, and one person to QC the plan set. The reviewers would look for errors and if any were found, then they

would need to be addressed before submittal. This adds significant amount of risk to the project. If any critical errors are found, there is a possibility that large parts of design would need to be redone. With this review occurring one to two weeks before submittal, there is a possibility that a large amount of overtime hours would need to be worked to be able to address all the comments and clean up the plan set before sent to the client. This leads to rushed efforts in the event of large amounts of changes needed to be made. When a plan set is rushed to be completed, errors are likely to be made, and even QC procedures may be skipped due to lack of time to complete.

### *Documentation*

The traditional method of QC and DC would include each person checking the plans to make their comments on the plan sheets in red pen. Changes that they would want made would be made with the red pen, and any comments or instructions they had would also be in red pen, however these instructions would have a "cloud" note around it to be able to distinguish the difference between the literal changes and additions with the suggestions/recommendations/instructions. At a time the plan set has been marked up it would then be sent to the CAD staff to make the necessary changes. When the changes were made a new "clean" document would be printed and then the engineer who reviewed the QC and DC would then compare the clean set against the marked up set and see that all the changes were made. Once this was complete, the document would be scanned in and then placed in the project folder on the company's server.

# *Proposed New Methodology*

## *Scope of Services*

As one can determine, there typically is nothing in the scope of services that details how the project will be reviewed. The QC process is one of the most important processes a project goes through, yet it is assumed it will be built into the hours by task and is not laid out in the scope of services. The author believes that there needs to be an emphasis in the QC process and needs to be written into the scope of services. A simple paragraph added in the scope will give the client extra confidence that their project is being designed and detailed correctly. This is something that can set a company apart from others. This item is often overlooked and assumed to occur, but adding it into the scope of services adds no risk to the firm, and will show the client that the project will be designed accurately. Thus, it is recommended that an item is to be added into the scope of services going forward that itemizes the consultant who is responsible for detail checking and performing a QC on every deliverable mentioned in the scope and the work breakdown structure.

## *Fee Proposal/Budget*

The new budget methodology will include an additional column in the fee proposal for hours required for QC. Each task will similarly be assigned the hours needed to complete each task, but will now include an additional line for the amount of time needed to QC and DC. This is done to reduce the risk of not assigning enough time for QC and DC, and to reduce the risk that the project will go over budget for QC and DC. By shifting hours from a holistic QC review process into a task delineated QC/DC separation, a more accurate fee proposal may be attained. See

Appendix **Figure 2. Sample Scope and Fee (With QC Hours)** for a sample Scope that contains hours for QC for each task.

## *Procedure*

The main difference in the change in methodology for the new detail checks is based on timing in the project lifecycle. Instead of the detail checks happening concurrently with the QC checks, the detail checks can occur when any aspect of the project has been designed. Once a portion of a project has been designed, and isn't subject to change for the rest of the project, it needs to then be checked at that time. Risk is added when the process is done at the end of the project, and is now shifted to the design phase. In the event that an error is found and redesign is needed, moving the process up in the timeline, and away from the deadline, may eliminate the increased spending and effort used updating errors found.

## *Documentation*

The new methodology for checking and documenting the QC and DC process follows a plan that XYZ calls the Design Quality Management Plan. This new plan emphasizes producing both a quality product and a quality process. It is the goal of XYZ to provide an outstanding product for the clients. The process that is followed to generate the product needs to comply with the DQMP. This process will break up the production of a plan set into different parts, by different teams reviewing the various pieces of the plan set. See Appendix **Figure 3. Sample Organizational Chart.**

This plan set that is being reviewed and commented on is called a check print set.

Unlike the original method of checking plans, this modified method will need to be reviewed by multiple people. This adds a separation of biases from one person to another. This is documented by having a check print stamp. See Appendix **Figure 4. Sample Check Print Stamp.** The stamp is to be placed on the first page of the plan set reviewed, and is to be signed and dated by each reviewer during the process. The proposed review, which is used for both the QC and DC process, is broken up into five pieces. These are the Originator, the Checker, the Backchecker, the Updater, and Rechecker. See Appendix **Figure 5. Sample QC Flow Chart.**

The Originator is the CAD operator responsible for creating the document to be reviewed. This is usually a CAD technician or an EIT. This person is the one who determine the original design and the one who will place the design information on the plan sheets, and the person with will put all the notes, construction notes etc., on the plan sheet to be reviewed. See Appendix **Figure 6. Sample QC Sheet** for a sample roadway-engineering plan sheet that contains QC comments.

The Checker is the person who reviews the plans and marks up the check print. This person is normally a senior engineer. The senior engineer is to be familiar with the type of engineering plans, the client who the plans are for, and competent in design to be able to correct any flaws. This is accomplished by using a color code. A yellow highlight indicates that the checker agrees that the information on the plan set is correct. A red mark will indicate that a correction is needed. A blue mark ill indicate a non-recorded comment, such as instructions or questions regarding a design. This is all documented on the plan set, and then each comment and correction is then added into the QC or DC form.

The Backchecker is one who takes a look at all the checkers comments and corrections and addresses each comment and correction. Any comment made by the checker will be provided in the form. The Backchecker is responsible with adding a red check to any red correction on the plan set if they agree with the comment or correction, and add a red X through the comment or correction if they disagree. The reasoning being the agreement or disagreement will be explained in the form that was filled out by the checker. This form is used to document any disagreements between checkers, so that a corrective course of action can be taken. This adds an extra benefit by having another engineers set of eyes on the design, so that not all comments and corrections are immediately addressed, and thus goes through another check before changes are made. See Appendix **Figure 7. Sample QC Form (Blank)** and **Figure 8. Sample QC Form (Completed)** for sample QC documents.

The Updater takes the check print set from the Backcheker and makes the necessary changes provided in the check print set. This person is typically a CAD technician. To show that the comments and corrections were addressed the updater will highlight the red corrections laid out by both the checker and Backchecker. Once the changes have been made it is the responsibility of the Updater to provide a clean document to the Rechecker for comment close out.

The Rechecker is responsible for making sure that all the comments were addressed correctly. This is usually an engineer. It is the responsibility of the Rechecker to add a green check mark on the check print set to the comments that were updated correctly. This is confirmed by comparing the check print against the clean documents provided by the updater. Once the process is complete then both the check print and clean documents need to be scanned into the correct

project folder for the QC and DC processes. In the event of a project QC/DC audit, the files can be quickly found, which will decrease the time spent searching. See Appendix **Figure 9. Sample QC Comment Process** for sample comments that would be found on a roadway-engineering plan sheet that conforms to the new methodology for the QC process.

## *Testing the System*

The new methodology was able to be tested across multiple projects based on where the individual project was at in its design. The Scope of Services and Fee Proposal/Budget goes hand in hand at the beginning of the project. The Proposed New Methodology was able to be applied to a KDOT pavement rehabilitation project on I-35 in Kansas City, MO. **Figure 2. Sample Scope and Fee (With QC Hours)** was used in practice to come up with the contract documents for the scope of services and the fee estimate for that project. One can see that there were additional hours allocated to the design for the QC process. This project was small enough in scope that the QC/DC hours were lumped in to the single QC hour section.

The procedural aspect of the Proposed New Methodology was tested on the Quivira Rd project in Overland Park, KS. With this project the author was responsible for the roadway design. Being in control of the design gave the author the ability to send the plans out to DC once the designs were completed to a final level. This was done with coordination with the Procedural aspect of the Proposed New Methodology as well. Once the designs were completed, the check print stamp was added and sent around to the various personnel within the company to sign on the responsibility they were needed for. This project did not use the QC/DC form since another medium was used to track comments. There is a computer program called Bluebeam that allows

PDFs to be commented on and responded to all in one program, acting like a live version of the QC/DC form. This program keeps track of who commented on what sheet, and when that comment was made. It also keeps track of who responded to comments and at what time as well. This session can be saved onto the company's server.

Testing of the Proposed New Methodology was all dependent on the availability of the projects the author was working on during the research period. The author was unable to test this Proposed New Methodology on a single project due to being moved from project to project, and not being heavily involved in a single project from start to finish. This is an unfortunate circumstance that comes with being a design engineer, and not a project manager. However, the author was able to train an intern still attending college in the Procedure and Documentation portion of the Proposed New Methodology. The same Quivira Rd project in Kansas City, MO was used for the basis of the training. The intern was able to sign and date the check print stamp under the Originator section, while the author was the Backchecker on the project. One other colleague was used as the Backchecker and Updater, while the author was able to sign the Rechecker portion on the project. It is the author's belief that training new engineers in this new practice early in their career will help establish good QC/DC practices going forward.

## Results

By planning early, documenting all the QC activities as designs are completed, allowing sufficient time for reviews, resolving all comments, and circling back with the reviewers well before submittal dates, submittals are less time consuming, and can focus on delivering the final product since the QC will have already been completed and documented. Completing the process

as the designs are completed will allow the reviewer to find any significant errors in the beginning, so that designs are not further developed based on original faulty designs. This stops the trickle of rework required to be done once an error is found late in design. With this process shifting from a couple weeks before the submittal, too often months in advance, time, effort, and most importantly budget, may all be saved using this new methodology.

However, there are some common causes of failure within this process that can lead to exacerbating effort and budget. Forgetting to document the QC paperwork can lead to headaches and confusion on design elements. If the project is ever audited, or if client comments come back asking for specific details, having an audit trail may reduce time spent searching for the requested items. This can cause the engineer to need to spend hours to go through the designs, emails, and check prints to follow the paper trail to find where decisions were made, and can simply be avoided by documenting the process. Another aspect that can lead to failures in this process is the reviewer not thoroughly checking designs, and expecting the next backchecker to catch failures. This can lead to the QC process quickly eating up budget, since back and forth reworks will continue multiple times over.

This updated process has also revealed that success of this process also relies heavily on the comments issued by the reviewers. There is a substantial difference between good and bad comments. The reviewer needs to have clear comments, so that the back checker and updater know precisely what needs to be done, and what specifically is wrong with the design, so that rework can be finished efficiently and accurately. Some examples of what constitutes a good comment are those that cite specific project requirements, detailed about what is non-compliant

in the design, are clear about the constraints of the fix needed, can be understood by other auditors through the documentation alone, and are easily closed if not based on requirements of the project. On the contrary, there can be what are considered bad comments with the QC review. Some examples of what constitutes a bad comment are those that have no basis with the project requirements, those that are meant to start discussions/meetings to lengthen the process, repeats of earlier comments, any comments that begin with “consider”, “it may be better to”, “explain”, etc. Some other examples would be open ended questions that want to know if other designs were considered, or other alternatives considered. While these comments would be helpful in preliminary design stages, these comments are not helpful in the final deliverable stages of the design. QC processes should not be seeking alternatives to design, just to make sure the design is accurate, and following the latest standards.

## Suggestions for Additional Work

Going through this new methodology for the QC review process for roadway-engineering plans has brought the attention to a few items that may want to be looked into further. First, it would be a good idea to bring up the QC hours in negotiations. When developing the scope in house, it would be nice to bring that to the contract negotiations. By breaking out the scope into tasks with QC hours attached to that, it may be possible to increase the amount of hours needed to complete certain tasks, and may potentially allow for more hours allowed for design. This may translate into more fees for a job, which can have the potential to increase the profit.

Another aspect to this new methodology that could warrant further research would be to interview co-workers at different levels and disciplines to have their thoughts on whether this is

beneficial, and see what they think are some ways to improve the process. This project only looks at the QC methods into the roadway side of an engineering project. The author would like to be able to expand that into different engineering disciplines such as structural engineering, and water resource engineering.

Next, the author would like to test this Proposed New Methodology throughout the life of a project, from project opening, to project closeout. While it is beneficial to be able to test various aspects from the new approach individually, to be able to test it on one project as a whole would be most beneficial. This would allow comparisons to similar scope projects with one being completely done with the new method, versus one be done with the original.

Finally, the author would like to compare the earned value charts of similar projects, one using the old method, and one using this updated method and compare the "burn rate" in the last month of the job to see if this new QC method had any impact on reducing the amount of time/money spent at the end of a project. This would be beneficial to be able to get some hardline metrics and data that can be used to get some real hours and money spent data on QC. Then using that data then it would be possible to calculate any reduction of QC hours for a given project, and thus be able to calculate how much more efficient this new approach to the QC process is, and more importantly how much money may be saved.

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# Appendices

## Figure 1. Sample Scope and Fee (No QC Hours).

| Item of Work | Senior Engineer | Sr. Project Manager | Traffic Engineer/ Enviro. Scientist | Project Engineer | E.I.T. Designer | CADD Technician | Surveyor | Survey Tech/Admin. | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Task II. Final Design** (Prepare 95% Unsealed Plans) | | | | | | | | | |
| **2.01.** Prepare detailed plans and specifications. | | | | | | | | | |
| A. Finalize cover sheet. | | | | 1 | | 1 | | | 2 |
| B. Finalize typical sections. | 1 | | | 2 | 2 | 4 | | | 9 |
| C. Final general notes and alignment/geometry data sheets. | | | | 1 | 1 | 1 | | | 3 |
| D. Subsurface drainage design – City to provide base thickness and material specification. HDR to provide edge drain layout or detail for "day-lighting" base to not trap water in intersection. Underdrain design will also include drainage of central island area. | | | | 1 | 4 | 4 | | | 9 |
| E. Final surface drainage design | | | | | | | | | |
| 1. Make final revisions to drainage area maps. | | | | | 1 | 1 | | | 2 |
| 2. Finalize storm conveyance plan. | | | | 1 | 2 | | | | 3 |
| 3. Finalize ditch and culvert design calculations | | | | | 2 | 2 | | | 4 |
| 4. Provide drainage calculations table sheet. | | | | 4 | 4 | 4 | | | 12 |
| 5. Finalize culvert profiles | | | | 2 | 2 | 2 | | | 6 |
| 6. Place ditch profiles on the roadway profile sheets | | | | 2 | 2 | 2 | | | 6 |
| F. Finalize Plan and Profile sheets with final geometric layout | | | | | | | | | |
| 1. Finalize Plan sheets - Scale = 1"= 20-ft. and shall include north arrow, sheet name and updates, revisions or additions due to development, design progression, review comments and/or title report updates to the follow: stationing, necessary dimensioning, mainline, side street and entrance baseline and geometric information, existing easements, proposed easements, approximate construction limits with labeling, tract numbers and ownership information based and final construction notes and call-offs. | | 1 | | 16 | 32 | 36 | | | 85 |
| 2. Finalize Profile sheets - scale H:1= 20-ft. V:1"=10 ft. and shall include sheet name and updates, revisions or additions due to design progression and/or review comments to the following: existing ground line, proposed ground line, final profile and curve information with stationing and call-offs, final roadway cross slope and/or super transition information, ditch profiles and final soil boring logs. | | 1 | | 4 | 16 | 20 | | | 41 |
| 3. Finalize central island profile sheet - scale H: 1-inch = 20-ft; V: 1-inch = 5-ft and shall include sheet name, existing ground line, proposed grade line for central island profile, curve information, stationing, elevation call-offs, roadway cross slope, and super transition information. | 1 | | | 3 | 4 | 6 | | | 14 |
| 4. Finalize roundabout intersection detail sheet - scale H: 1-inch = 20-ft; Includes sheet name, plan view of roundabout, curb station/elevation, flow arrows, geometry callouts, sidewalk and multi-use path details, radii/curb return callouts, and stationing. | 1 | | | 3 | 4 | 6 | | | 14 |
| 5. Prepare and finalize splitter island details - scale H: 1-inch = 20-ft; Includes sheet name, splitter island geometry callouts, curb station/elevation, flow arrows, curb ramp/sidewalk details, and ADA compliance dimensions for curb ramps and splitter island opening/ramps. | 1 | | | 3 | 4 | 6 | | | 14 |
| G. Prepare concrete joint layout plans and details | 1 | 1 | | 2 | 6 | 8 | | | 18 |
| H. Final pavement marking and signing plans. | | | | | | | | | |
| 1. 1"=40' scale plan sheets with proposed pavement marking and signing indicated with limited notes, dimensions and stationing as needed. | | | 1 | 1 | 2 | 4 | | | 8 |
| 2. Finalize project specific general notes and standard City details. | | | | | 1 | 1 | | | 2 |
| I. Final street lighting plans for roundabout intersection | | | | | | | | | |
| 1. 1"=40' scale plan sheets with proposed street lighting poles, conduit and controller layout indicated. | | | 8 | 8 | 8 | 8 | | | 32 |
| J. Final adjustments to proposed right-of-way, easement limits and/or ownership information. Owner requested change(s) that requires changes to legal description, appraisal or completed acquisition will not be considered part of these Basic Services. | | | | 1 | 1 | 1 | | | 3 |
| K. Finalize cross sections every 25 feet at 1"=10' H and 1"=5' V | | | | | | | | | |
| 1. Final roadway templates to represent the roadway cross section(s) and pavement section(s) throughout the | | | | 2 | 4 | | | | 6 |
| 2. Include variable grading area(s) in model. | | | | 2 | 4 | | | | 6 |
| 3. Final proposed roadway model | | | | 2 | 4 | | | | 6 |
| 4. Develop final cross sections | | | | | 4 | 8 | | | 12 |
| 5. Edit cross sections as needed (includes match lines for driveways and intersections) | | | | | | 2 | | | 2 |
| 6. Annotate cross sections with the profile grade, roadway, shoulder and cut/fill slopes | | | | | 1 | 2 | | | 3 |
| L. Final updated construction (grading) limits to be included and noted on plans. | | | | | 1 | 1 | | | 2 |
| M. Final traffic control for construction plans. | | | | | | | | | |
| 1. Update project specific traffic control general notes and City standard details. | | | | | 1 | 1 | | | 2 |
| 2. Finalize the detour plans and traffic control sheet(s) developed for field check. Showing layout, sections and details needed for either detouring traffic around intersection or maintaining traffic through intersection during the allowable phases. | 2 | 1 | | 4 | 8 | 8 | | | 23 |
| N. Phased erosion and sediment control (ESC) plans meeting City and NPDES requirements. | | | | | | | | | |
| 1. Create narrative explanation and plan layout of the phased ESC plan. | | | | | 2 | 2 | | | 4 |
| 2. Check design for 2-year return interval (hydraulic analysis) | | | | | 2 | | | | 2 |
| 3. Assumes NO non-standard BMPs included in this plan | | | | | | | | | 0 |
| 4. Develop phased ESC quantities and include summary table of these for each phase | | | | 1 | 4 | 2 | | | 7 |
| 5. Review final design with City staff and make requested revisions | | | 1 | | 1 | 1 | | | 3 |
| 6. NPDES land disturbance Permit (NOI) through KDHE | | | | 2 | 4 | | | | 6 |
| O. Standard City of OP and project specific construction detail sheets (Make copies of City standard drawings assembled for the Quivira Road project) | | | | 2 | 2 | 2 | | | 6 |
| P. Review specifications and special provisions prepared by the City. Assumes single review and comments provided to City. | | 2 | | 4 | | | | | 6 |
| Q. Quality assurance review. | 4 | 4 | 8 | | | | | | 16 |
| **2.02. Utility Coordination.** | | | | | | | | | |
| A. Schedule and attend up to 2 utility coordination meetings (for a standalone roundabout intersection project). (2 additional meetings will be held as joint meeting with the currently contracted Quivira project) Assumes 2 people for 2 hours with meeting minutes prepared and distributed for each meeting. | | 4 | | 6 | | | | | 10 |
| B. Prepare agendas and list of conflicts table for each meeting. Assemble into KDOT 1304 Status of Utilities form. | | | | | 8 | | | | 8 |
| C. Color plan/profile strip drawings with utilities shown | | | | | 2 | 4 | | | 6 |
| D. Assist utilities with conflict coordination | | | | | | | | | |
| 1. Provide electronic base maps to all utilities for their use in developing relocation plans | | | | | 2 | 2 | | | 4 |
| 2. Compile a master utility relocation drawing from the individual utility's electronic relocation plans provided above. These plans are intended to facilitate timely and more accurate coordination among utilities and are NOT intended for construction or locating purposes. HDR does NOT guarantee the accuracy of these compiled utility drawings nor the possible conflicts not indicated in these plans. | | | | | 6 | 2 | | | 8 |
| E. Color utility coordination plan set (11"x17") for each utility once relocation plans are available. | | | | | 2 | 2 | | | 4 |
| F. Stake project centerline every 100 feet as needed for utility relocation purposes. Assumes single staking of project baselines. | | | | | | | 1 | 8 | 9 |
| **2.03.** Opinion of probable construction cost. | | | | | | | | | 0 |
| A. Finalize construction quantities and quantity summary tables. | | 2 | 6 | 6 | 16 | 12 | | | 42 |
| **2.04.** Office Check Plans. | | | | | | | | | |

## Figure 2. Sample Scope and Fee (With QC Hours).

**Appendix A - Fee Estimate**

**Kansas Department of Transportation**
**I-35 Overlay Project, Johnson Co.**
**Hour and Fee Estimate -**

**9/19/2018**

| | | | Hours | | | | | | | | | Dollars | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Principal | Proj Mgr | QC | Sr. Rdwy Eng | Roadway Eng | Cad Tech | Sr. Traffic Eng | Traffic EIT | Clerical | Total Hrs | Budget (Labor +OH +Fixed Fee) | Expenses | Total Task Budget |
| | | Wage Rate | | | | | | | | | | | | |
| | | Billing Rate | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | |
| **Project Summary** | | | | | | | | | | | | | | |
| A | Evaluate Existing Roadway Conditions | Evaluate EX. Surface for Cross Slope Deficiencies | | | | 8 | 40 | | | | | 48 | $0 | $0 | $0 |
| | | Determine Superelevation at Existing Horizontal Curves | | | | 2 | 8 | | | | | 10 | $0 | $0 | $0 |
| | | Review Existing Plans | | | | | 4 | | | | | 4 | $0 | $0 | $0 |
| | | Evaluate Ex. Min. Vertical Clearances at Bridge & Sign Truss | | | | 2 | 12 | | | | | 14 | $0 | $0 | $0 |
| | | Attend Site Review of Project | | 4 | | | 4 | | | | | 8 | $0 | $0 | $0 |
| | | QC Existing Roadway Evaluations | | | 4 | | | | | | | 4 | $0 | $0 | $0 |
| | | | | | | | | | | | | 0 | $0 | $0 | $0 |
| | | | | | | | | | | | | 0 | $0 | $0 | $0 |
| | | | | | | | | | | | | 0 | $0 | $0 | $0 |
| | | **Subtotal** | **0** | **4** | **4** | **12** | **68** | **0** | **0** | **0** | **0** | **88** | **$0** | **$0** | **$0** |
| B | Evaluate Proposed Roadway Conditions | Analysis of Proposed Cross Slope Corrective Measures | | | | 4 | 16 | | | | | 20 | $0 | $0 | $0 |
| | | Analysis of Proposed Vertical Clearance Corrective Measures | | | | 2 | 8 | | | | | 10 | $0 | $0 | $0 |
| | | Analysis of Overlay Transitions at Existing Drainage Structures | | | | 1 | 4 | | | | | 5 | $0 | $0 | $0 |
| | | QC Proposed Roadway Evaluations | | | 4 | | | | | | | 4 | $0 | $0 | $0 |
| | | | | | | | | | | | | 0 | $0 | $0 | $0 |
| | | **Subtotal** | **0** | **0** | **4** | **7** | **28** | **0** | **0** | **0** | **0** | **39** | **$0** | **$0** | **$0** |

## Figure 3. Sample Organizational Chart.

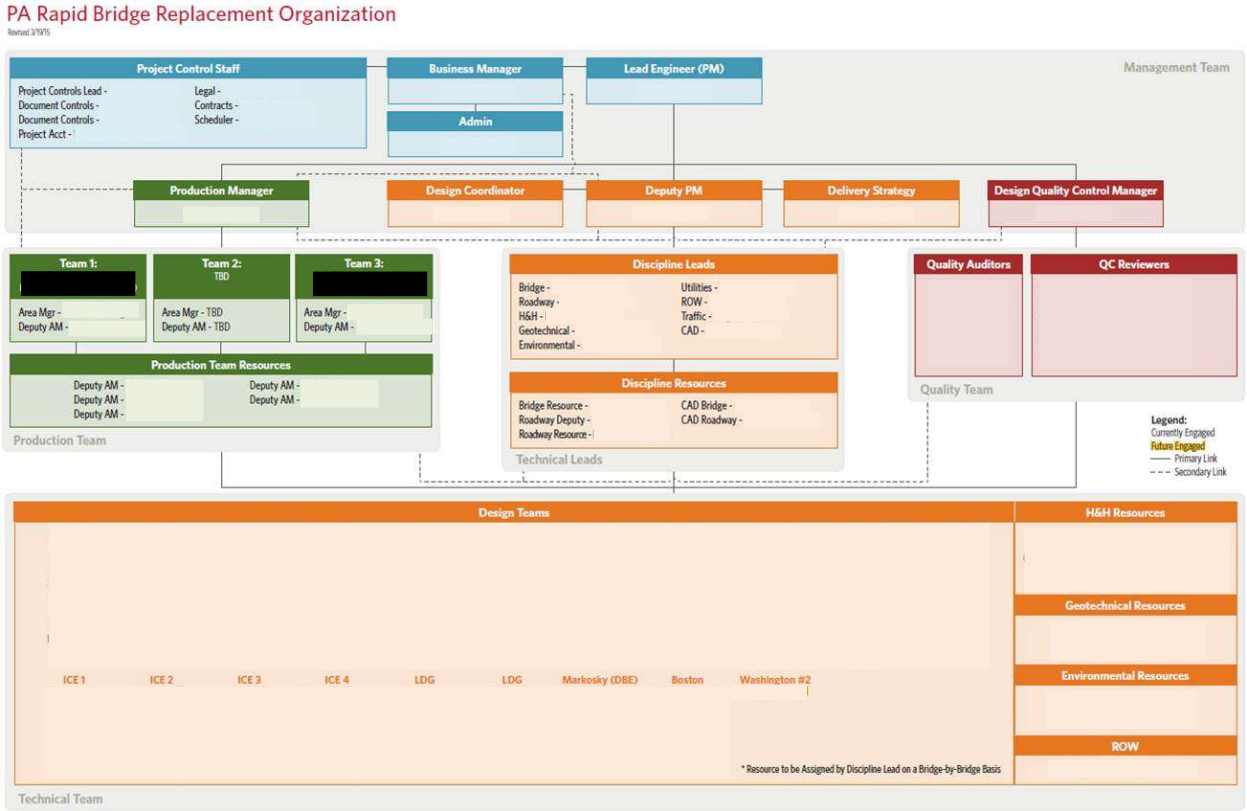


**Figure 4. Sample Check Print Stamp.**

**Figure 5. Sample QC Flow Chart.**

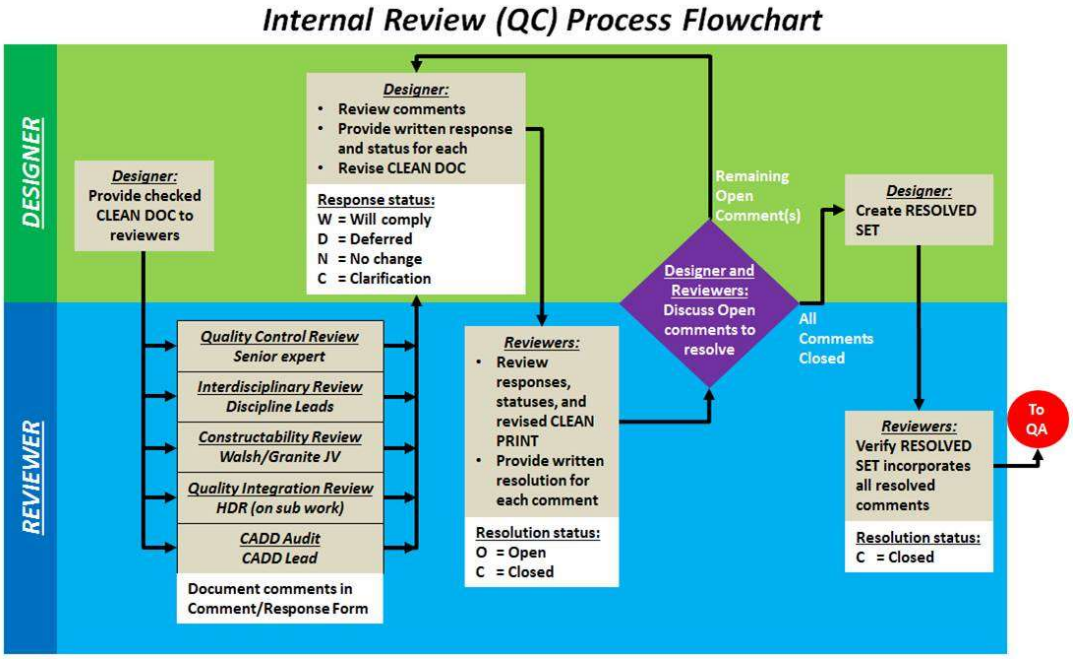
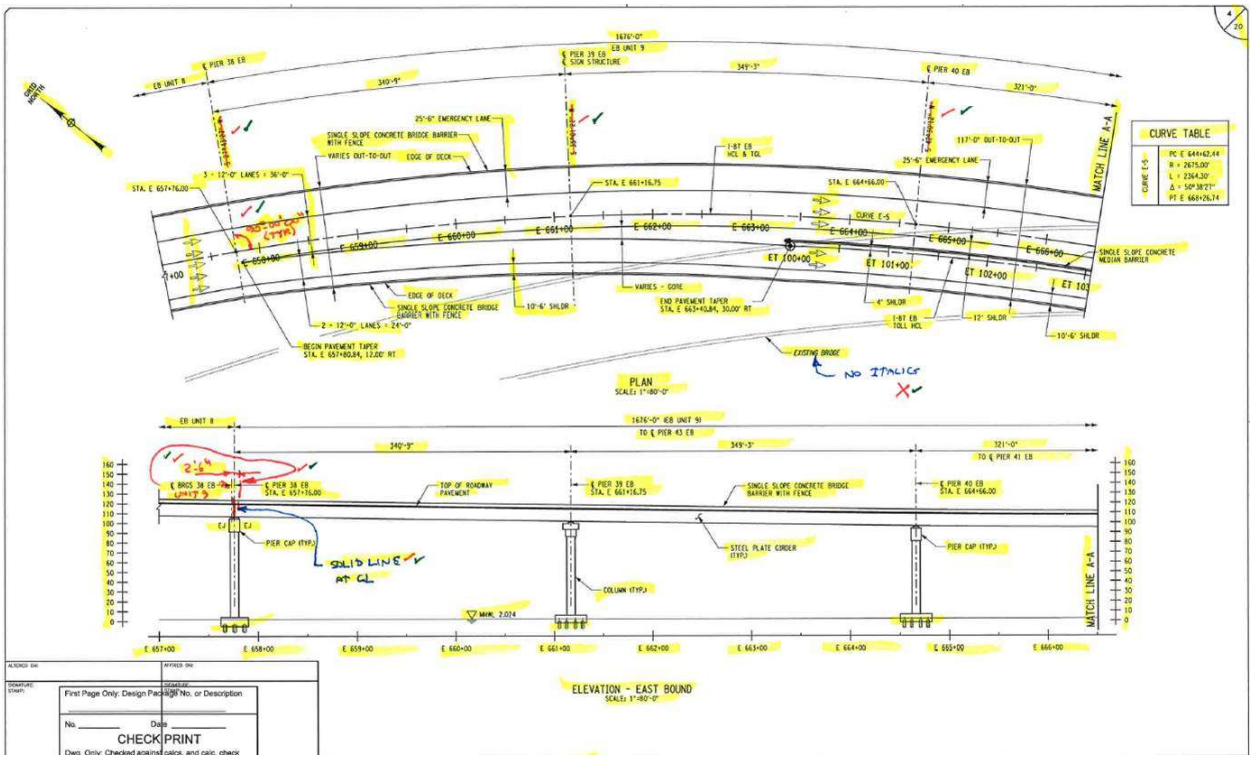


**Figure 6. Sample QC Sheet.**



## Figure 7. Sample QC Form (Blank)

Form DCPR 11B

CR, IDR and QCR COMMENT SHEET

Project: [redacted] Responsible Professional:

Design Package No.: Field Check Reviewer Name:

Review Type: CR [ ] IDR [ ] QCR [ X ] Sheet 1 of 1

Design Manager: Review Deadline:

Design Discipline Lead

| Sheet/ Page No. | Comment No. | Reviewer Comment | Responsible Professional Response | Status[1] | Date | Reviewer App'd. (Initials) |
|---|---|---|---|---|---|---|
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(1) Status code: C = complied; R = complied w/ agreed upon revisions; D = Deleted; O = Open

**Figure 8. Sample QC Form (Completed).**

Form DCPR 11B

CR, IDR and QCR COMMENT SHEET

Project: [redacted] Responsible Professional:

Design Package No.: Field Check Reviewer Name:

Review Type: CR [ ] IDR [ X ] QCR [ ] Sheet 1 of 3

Design Manager: Review Deadline:

Design Discipline Lead

| Sheet/ Page No. | Comment No. | Reviewer Comment | Responsible Professional Response | Status[1] | Date | Reviewer App'd. (Initials) |
|---|---|---|---|---|---|---|
| | 1 | Is there a reason the pipes that outfall to ditches do not outlet at the flow line? | Yes – We designed the flow line of the pipe to outlet at the ditch elevation of the ditch. The pipe was stopped where the top of the pipe matched the grade from the fill slopes from the road. From there we will add outlet protection to the ditch at a later submittal. | O | 6/20/18 | |
| | 2 | Name the inlet in InRoads the same as your inlet ID on the plans | Agree – Will do if budget allows since we will not deliver the InRoads data to the client | C | 6/20/18 | |
| | 3 | Runoff spelled with one 'n' | Agree - Updated | C | 6/20/18 | |
| | 4 | See PDF markups Drainage Design QC_Checked.pdf | | | | |
| 4 | 5 | Calculated Intensity Doesn't exactly match inroads input | Rounding differences, only off by 0.1. Should be OK | C | 6/20/18 | |
| 4 | 6 | Suggest the design point name to match the inlet name if basin drains to inlet. If basin drains to ditch, name the design point to match the structure at the end of the ditch (pipe or pond). | Agree – Will do if budget allows since we will not deliver the InRoads data to the client | O | 6/20/18 | |
| 5 | 7 | Drainage area D4 Area needs to be 4.50 ac. | Agree – updated. | C | 6/25/18 | |
| 6 | 8 | Why does flow from show no flow on inlets? | Not exactly sure why this is. I assigned the area to the inlet and since the inlet's opening isn't "free" it shows as none. Will remove the column from the check printout. | C | 6/20/18 | |
| 6 | 9 | No Pipe Profile for P406 | Added | C | 6/25/18 | |
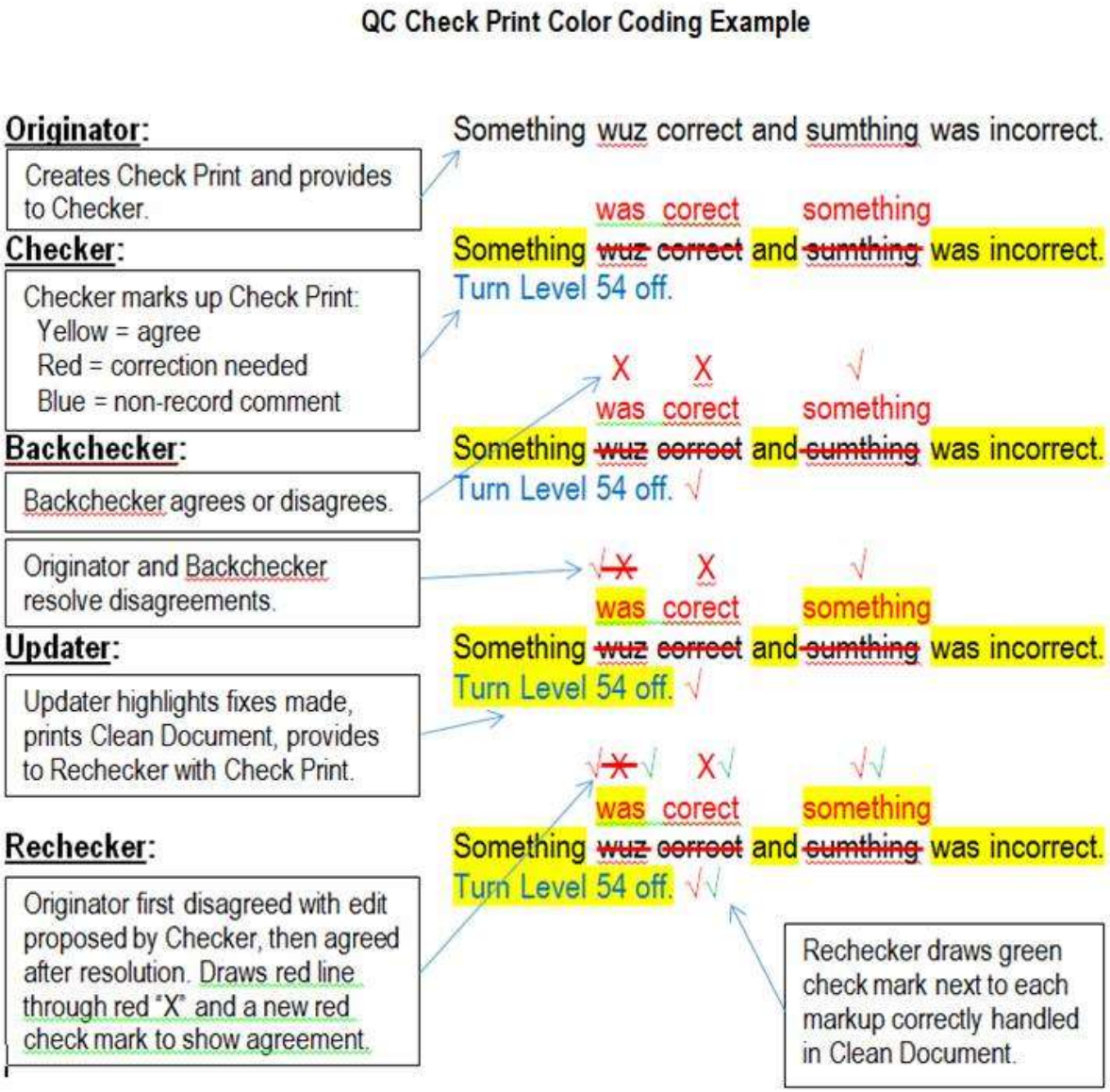
**Figure 9. Sample QC Comment Process.**